Cambridge Centre for Risk Studies

Research Showcase 22 June 2015

SPECIAL TOPICS SEMINAR

Centre for Risk Studies

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Risk Studies

UNIVERSITY OF CAMBRIDGE
Judge Business School

CJBS 25

09:30-14:30: Research Showcase and Special Topics Seminar

09:30 -09:50 — ***Session 1: The Emerging Risk Landscape***
A Multi-Threat View of Risk
Professor Daniel Ralph, Academic Director, Cambridge Centre for Risk Studies

09:50 -10:10 — **Catastronomics: the economics of catastrophes**
Dr Scott Kelly, Research Associate, Cambridge Centre for Risk Studies

10:10 -10:30 — **Identifying & Managing Emerging Risks**
Nick Beecroft, Emerging Risks, Lloyd's

10:30 -11:00 — Coffee Break

11:00 -11:20 — ***Session 2: Financial Catastrophe Risk***
Understanding Financial Catastrophes
Dr Andrew Coburn, Director of Advisory Board, Cambridge Centre for Risk Studies, and Senior Vice President, RMS Inc.

11:20 -11:40 — **Learning from Historical Financial Crises**
Dr Duncan Needham, Director, Centre for Financial History, University of Cambridge

11:40 -12:00 — **The Cambridge Model of Banking Contagion**
Dr Olaf Bochmann, Research Associate, Centre for Risk Studies

12:00 -12:20 — **Financial Cartography**
Dr Kimmo Soramäki, Founder & CEO, Financial Network Analytics

12:20 -13:30 — Lunch

13:30 -13:55 — ***Session 3: Cyber Catastrophe – an interlinked Systemic Risk***
Understanding Cyber Risk
Simon Ruffle, Director of Technology Research and Innovation, Cambridge Centre for Risk Studies

13:55 -14:20 — **Developing Cyber Catastrophe Scenario**
Éireann Leverett, Research Associate, Cambridge Centre for Risk Studies

14:20 -14:30 — **Managing Systemic Risk**
Professor Daniel Ralph, Academic Director, Cambridge Centre for Risk Studies

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Research Showcase 22 June 2015

A MULTI-THREAT VIEW OF RISK: PUTTING A VALUE ON CITY RESILIENCE

Professor Danny Ralph

Academic Director

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Dr Andrew Chaplin
Risk Researcher

Centre for Risk Studies Mission

To be the world's leading academic centre for research into systemic risk in business, the economy, and society

Cambridge Risk Framework
Macro-Threat Taxonomy Version 2.0

Financial Shock

Asset Bubble

Financial Irregularity

Market Crash

Sovereign Default

Bank Run

Trade Dispute

Labour Dispute

Trade Sanctions

Cartel Pressure

Nationalization

Tariff War

Geopolitical Conflict

Conventional War

Asymmetric War

External Force

Civil War

Nuclear War

Political Violence

Terrorism

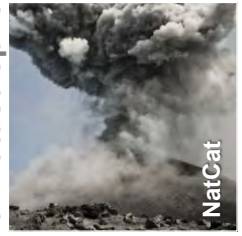
Separatism

Organized Crime

Assassination

Civil Disorder

Natural Catastrophe



Earthquake

Windstorm

Volcanic Eruption

Flood

Tsunami

Climatic Catastrophe

Drought

Freeze

Tornado & Hail

Electric Storm

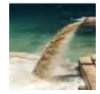
Heatwave

Environmental Catastrophe

Sea Level Rise

Ocean System Change

Wildfire



Pollution Event

Atmospheric System Change

Technological Catastrophe

Nuclear Meltdown

Industrial Accident

Cyber Catastrophe

Technological Accident

Infrastructure Failure

Disease Outbreak

Human Epidemic

Animal Epidemic

Waterborne Epidemic

Zoonosis

Plant Epidemic

Humanitarian Crisis

Famine

Water Supply Failure

Child Poverty

Welfare System Failure

Refugee Crisis

Externality

Meteorite

Solar Storm

Space Threat

Ozone Layer Collapse

Satellite System Failure

Other

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Can We Understand Emerging Risks?

Pandemics

Social Unrest

Geopolitical Conflicts

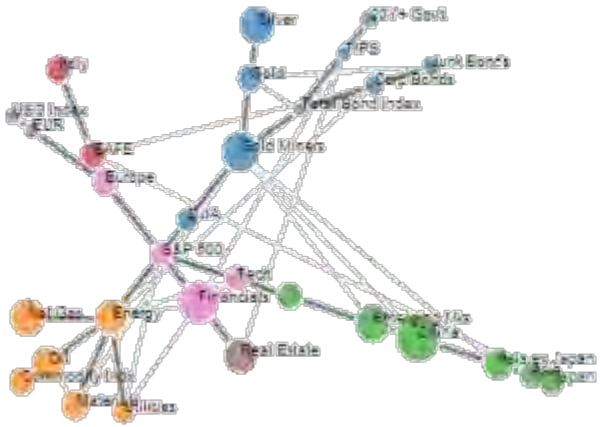
Cyber

And assess their potential to cause:

Primary Impacts and Costs

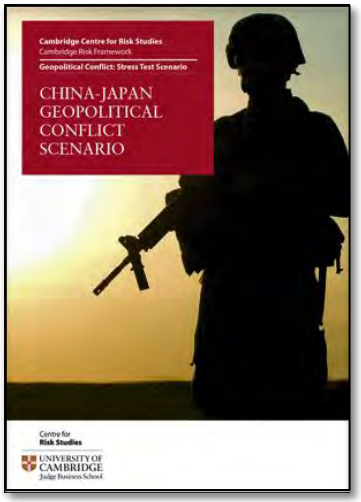
Operational Impacts and Macroeconomic Effects

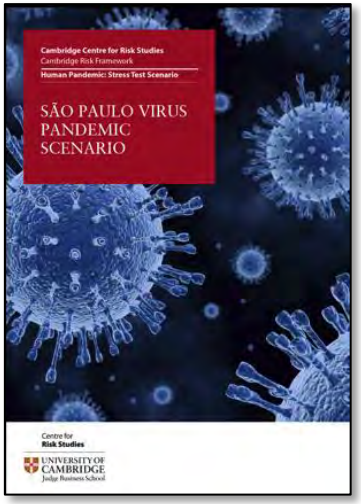
Market Risk and Investment Portfolio Impact

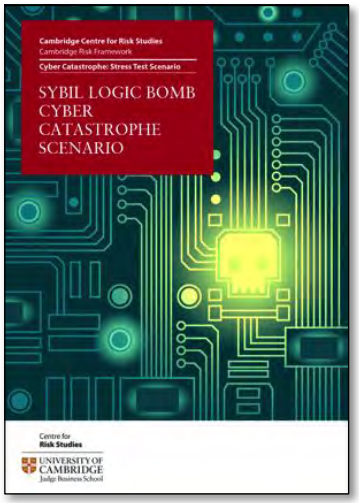


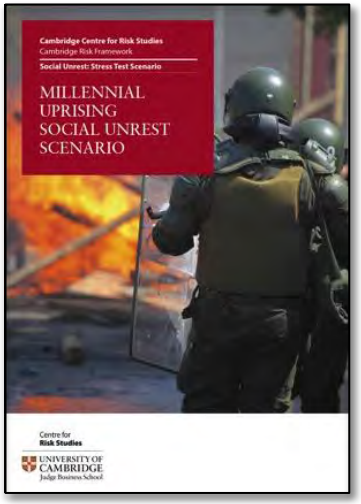
Stress Test Scenario Reports

2014

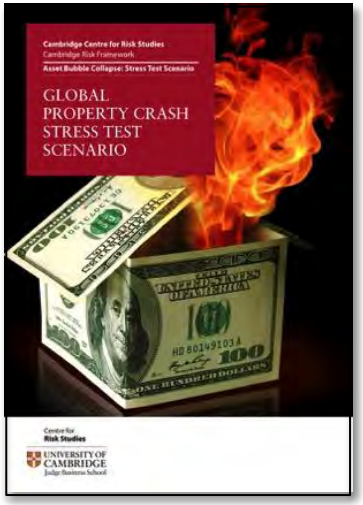


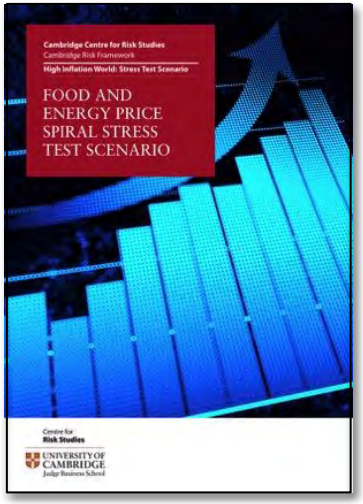


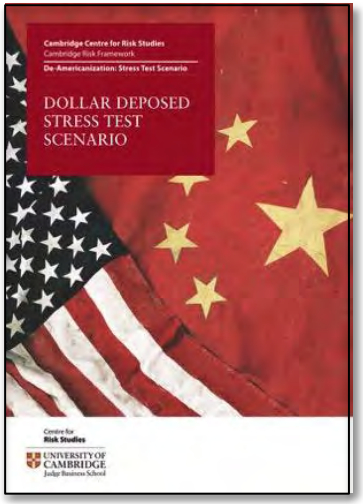




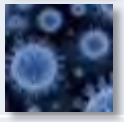
2015







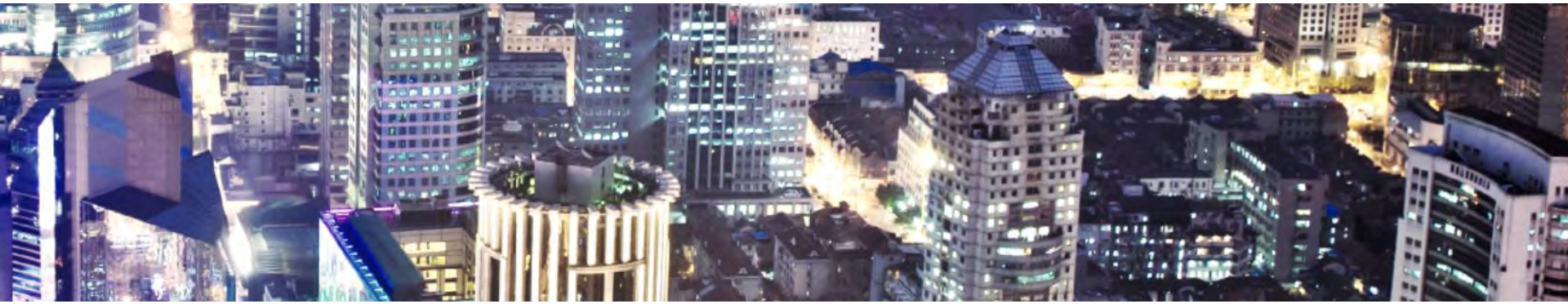
Cambridge Scenarios: GDP@Risk

GDP@Risk US$ Trillion	S1	S2	X1
 Geopolitical Conflict **China-Japan Conflict**	**17**	27	34
 Asset Bubble Shock **Global Property Crash**	**11**	16	23
 Pandemic **Sao Paolo Virus**	**7**	10	23
 Sovereign Default Shock **Eurozone Meltdown**	**6**	13	20
 Food and energy price spiral **High Inflation World**	**5**	8	11
 Cyber Catastrophe **Sybil Logic Bomb**	**4.5**	7	15
 Social Unrest **Millennial Uprising**	**2**	5	8
 De-Americanisation of Financial System **Dollar Deposed**	**2**	2	-2
2007-2012 Great Financial Crisis	18		
Great Financial Crisis at 2014	**20**		

What is the Value of Resilience?

- Address “Pandora’s box” of all risks
  - “Universal” Cambridge Taxonomy of Threats
- Very large and very unlikely shocks
  - Events whose scale makes them **unpredictable**
- Model their impacts in a simple probabilistic way
  - Analogous to insurance risk modelling for Nat Cat
  - Estimate the cost to a business, city, region, or the global economy, resulting from all catastrophic shocks.
- Measure loss to Gross Domestic Product, “GDP@Risk”
  - Use GDP@Risk to bound value of resilience

An example: Cambridge World Cities Risk Index



- C.f., Lloyd's Cities Risk Index
  - Also a Cambridge Centre for Risk Studies project
  - Due for release Sep 2015
- Cambridge World Cities looks at
  - 20+ threat types
  - 300 of world's top cities by GD

⇨ Simple = **scalable** model of threat types and city characteristics

300 World Cities Model Overview

- **Hazard analysis** for each threat type
- **City analysis**
  - **Vulnerability analysis** of each city for each threat:
    What is the immediate impact of a catastrophe?
  - **Resilience analysis** of each city:
    How long does it take to recover?

1

Natural Catastrophe & Climate

Earthquake

Volcanic Eruption

Windstorm
- Tropical
- Temperate

Flood

Tsunami

Drought

Freeze

Heatwave

2

Financial, Trade & Business

Market Crash

Sovereign Default

Oil Price Shock

3

Politics, Crime & Security

Interstate War

Separatism

Terrorism

Social Unrest

4

Technology & Space

Power Outage

Cyber Catastrophe

Solar Storm

Nuclear Meltdown

5

Health & Environmental

Human Epidemic

Plant Epidemic Crop Failure

20+ Threats Modelled

Risk Data Repository

Compiled in Cambridge Risk Framework

Trade & Economics
- International Trading Data
- Global Companies Trade

Finance
- Global Banks lending & ownership

Country Data
- Key Attributes
- Demography + pop & age projections
- Economics – national models
- Military power structure

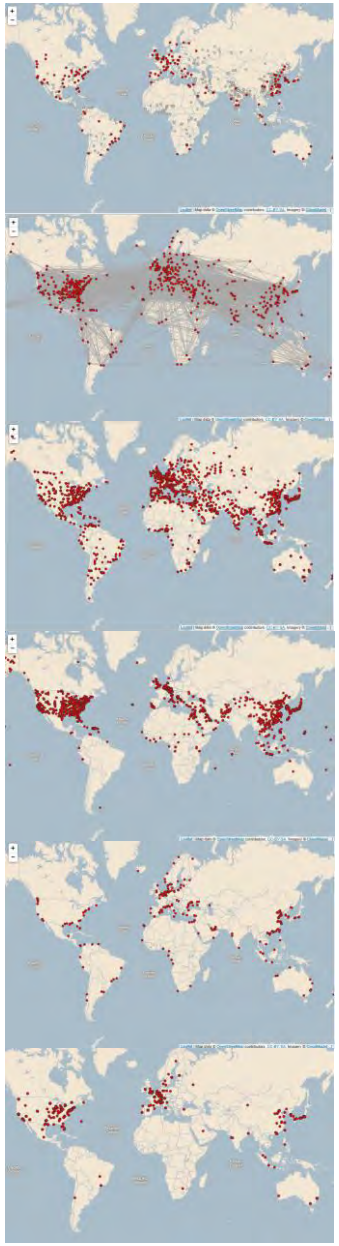
City Data
- Demographics & base data
- Economics + GDP forecasts to 2025

Transportation
- Air traffic network
- Shipping traffic network
- Rail
- Roads

Threat Maps of World
- 23 Threats mapped & modelled

Energy
- Electricity
- Gas
- Oil

Telecommunications
- Data
- Telephony



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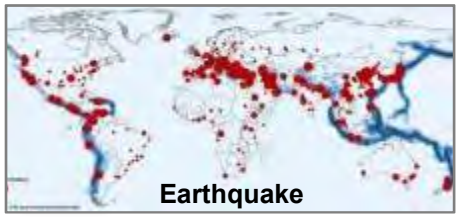
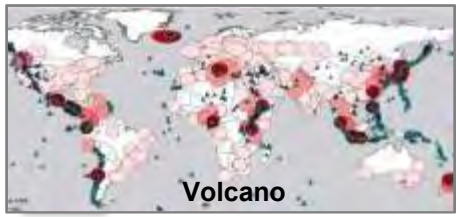
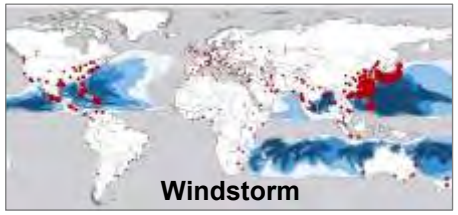
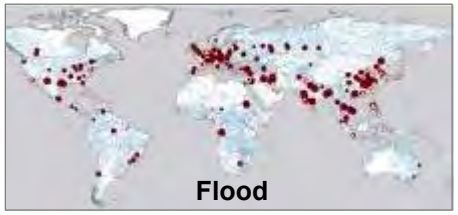
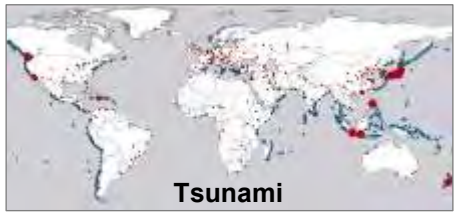
- Status: Completed
- In progress/partial
- Initial structure

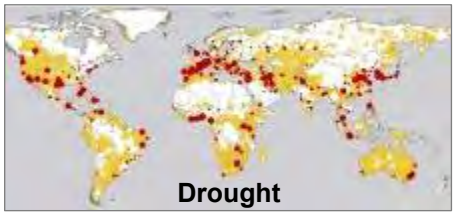


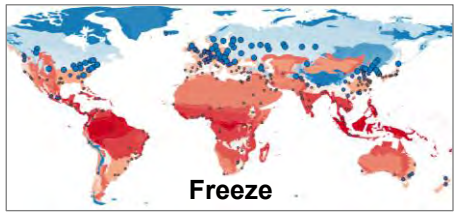


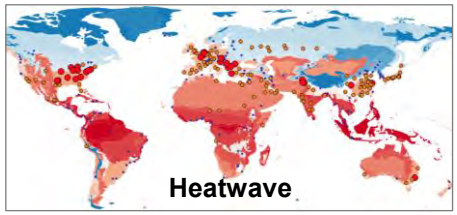


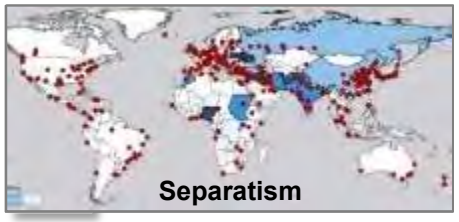


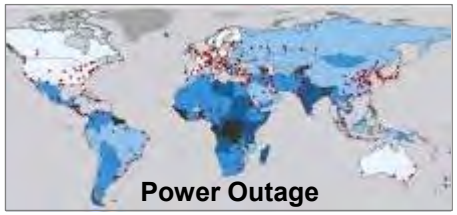


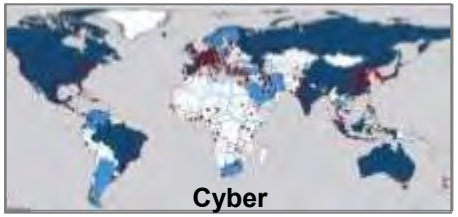


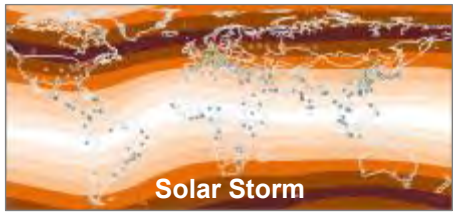


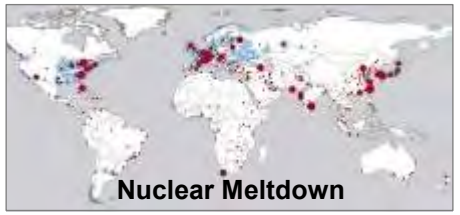












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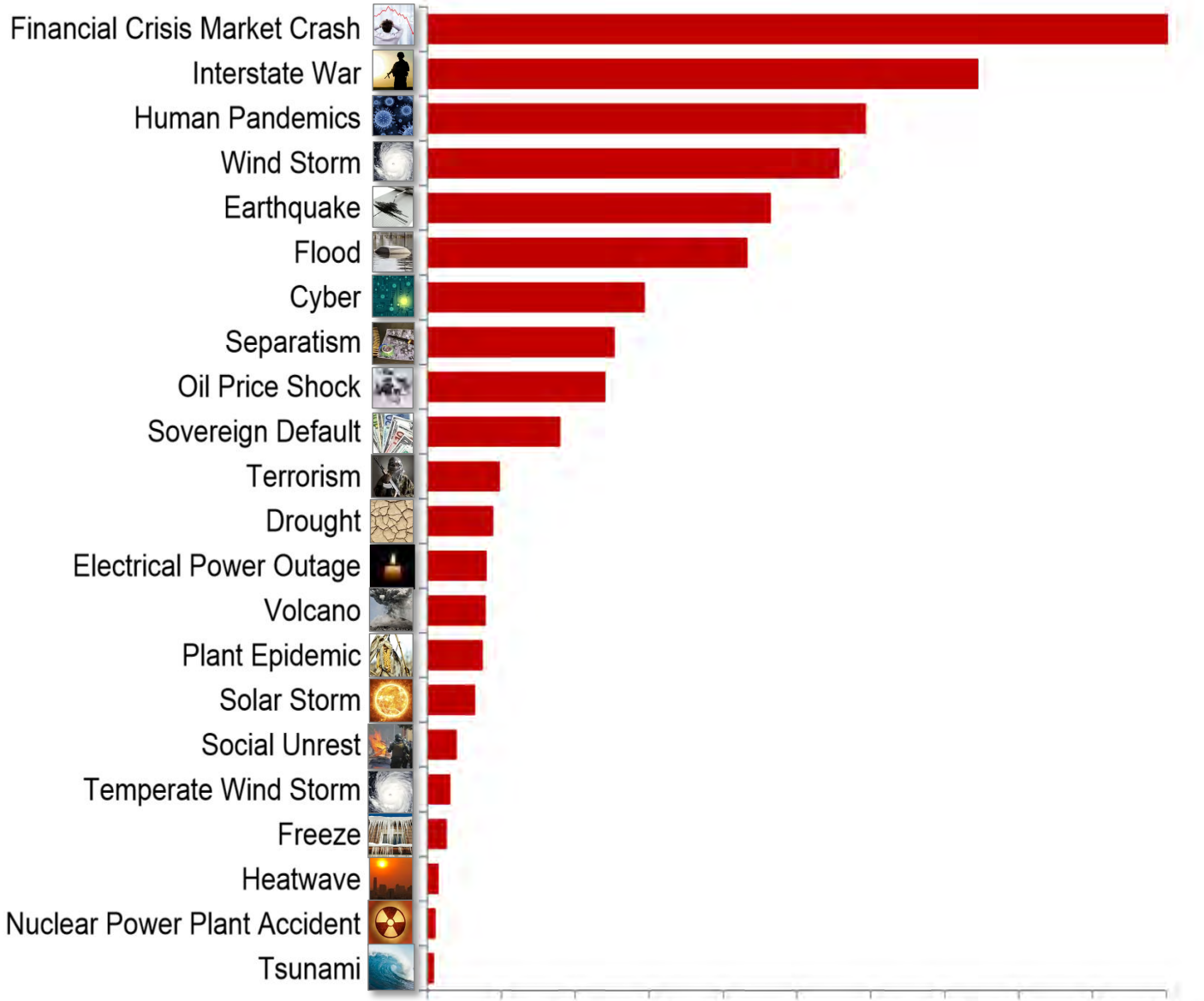
Cambridge Risk Atlas

Cambridge Centre for Risk Studies
Cambridge World Cities Risk Index

- GDP@Risk 2015-2025 is $5.4 Tn
  - 1.4% of total GDP forecast, $370 Tn
- Value of Improving Resilience
  - Reduce GDP@Risk by 10% to 25%
  - Gain of $ 0.5 Tn to $1.4 Tn

GDP@Risk from Top 20 Threats to the Global Economy



GDP@Risk from 2015 to 2025

Multi Threat Project ⇨ Where Next?

- World Cities at Risk essentially adds up impacts across 20-some threat types and 300 cities
  - Events and cities are treated as independent
  - ⇨ **Introduce coherence**
- What is the arithmetic of catastrophe?
  - Does a combined 1-in-50 year Hurricane and 1-in-50 year Sovereign Default cause more havoc than a 1-in-100 year event?
  - ⇨ **Nonlinearity of combined effects**
  - Can a War cause a Pandemic resulting in far greater mortality than either event on their own?
  - ⇨ **Cascading risks**

Conclusion

- Analysis of systemic risks requires
  - A **universal** or holistic approach to perils
  - Acknowledgement that in our environment
    - **Catastrophes are inherent**
    - **Catastrophes are unpredictable**
- Putting a value on resilience requires this view
  - Eg, GDP@Risk for the World Cities
- Holistic framework provides an antidote to fixating on yesterday's news

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