

Cambridge Centre for Risk Studies
Advisory Board Research Showcase – 24 January 2017



Cambridge Centre for Risk Studies Welcome & Research Overview

Centre for
Risk Studies



Professor Danny Ralph
Academic Director
Cambridge Centre for Risk Studies

CCRS Research Overview AGENDA

0930-1030 **Session I – Emerging and Systemic Risk Research**

Welcome and CCRS Research Overview

Prof Danny Ralph

Cyber Risk Research at CCRS

Jennifer Copic

Geopolitical Risk and Catastrophe Threats

Tamara Evan

Multi-Line Insurance Exposure Data

Kayla Strong

10:30-11:00 Coffee Break

11:00-11:45 **Session II - Putting it all together: Project Pandora**

Trillion Dollar Catastrophe Scenarios

Simon Ruffle

Methods for Generating Threat Scenario Sets

Jessica Tsang

Modelling Economic Contagion

Dr Ali Rais Shaghaghi

Multi-Threat Cascades

Arjun Mahalingam

Adding Stocks to the Pandora Framework

Dr Andrew Skelton

12:00-12:45 **Session III - Use Cases and Applications**

Benefits of Improving Infrastructure Resilience

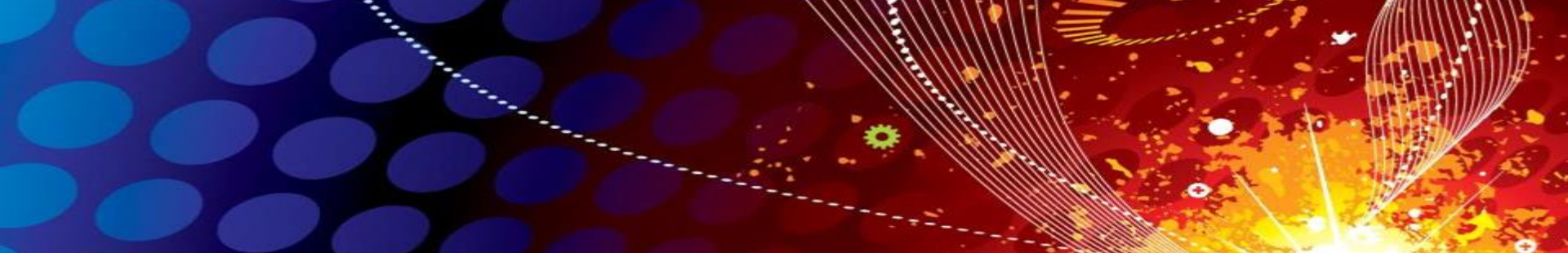
Dr Edward Oughton

Towards the Resilient Enterprise: Corporate Risk Profiling

Dr Michelle Tuveson

Insurance Use Cases of Risk Research at CCRS

Dr Andrew Coburn



Centre for Risk Studies Mission Statement

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

Strategy to achieve this

- **Engagement** – Develop & disseminate research, Thought leadership
- **Risk Research** – Developing methodologies for solving risk problems
- **Academia** – Contributing to CJBS Community

- **Scenarios – Foundation of Cambridge Risk Framework**
- **Analytics**
- **Use Cases**

Cambridge Risk Framework

- Motivated to understand
 - Catastrophe modeling and extreme risk analytics
 - Failure of complex systems and networks
 - Science of resilience to catastrophic failures
- To answer questions such as:

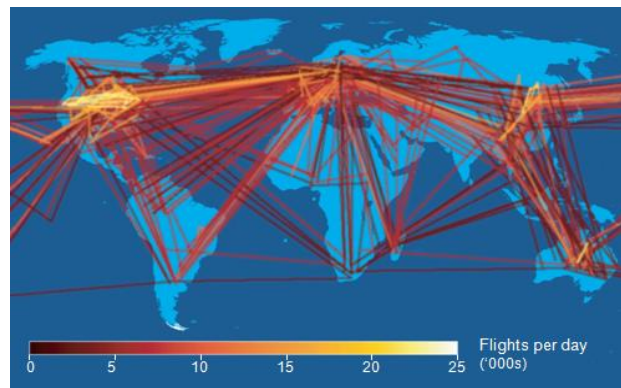
How would

[War in China] affect [Trade Networks] and impact [Global Economy]?

Regional Conflict **Scenario**



System@Risk: Air Travel Network



Loss metrics



Beyond NatCat: Cambridge Taxonomy of Threats

Financial Shock



FinCat



Asset Bubble



Financial Irregularity



Market Crash

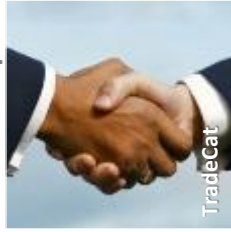


Sovereign Default



Bank Run

Trade Dispute



TradeCat



Labour Dispute



Trade Sanctions



Cartel Pressure



Nationalization



Tariff War

Geopolitical Conflict



WarCat



Conventional War



Asymmetric War



External Force



Civil War



Nuclear War

Political Violence



HateCat



Terrorism



Separatism



Organized Crime



Assassination



Social Unrest

Natural Catastrophe



NatCat



Earthquake



Windstorm



Volcanic Eruption



Flood



Tsunami

Climatic Catastrophe



WeatherCat



Drought



Freeze



Tornado & Hail



Electric Storm



Heatwave

Environmental Catastrophe



EcoCat



Sea Level Rise



Ocean System Change



Wildfire

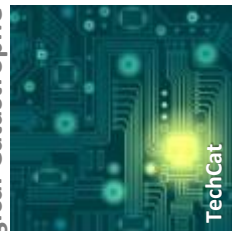


Pollution Event



Atmospheric System Change

Technological Catastrophe



TechCat



Nuclear Meltdown



Industrial Accident



Cyber Catastrophe

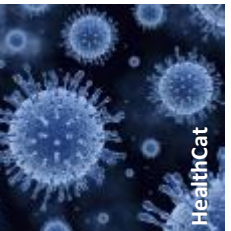


Technological Accident



Infrastructure Failure

Disease Outbreak



HealthCat



Human Epidemic



Animal Epidemic



Waterborne Epidemic



Zoonosis



Plant Epidemic

Humanitarian Crisis



AidCat



Famine



Water Supply Failure



Child Poverty



Welfare System Failure



Refugee Crisis

Externality



SpaceCat



Meteorite



Solar Storm



Space Threat



Ozone Layer Collapse



Satellite System Failure

Other

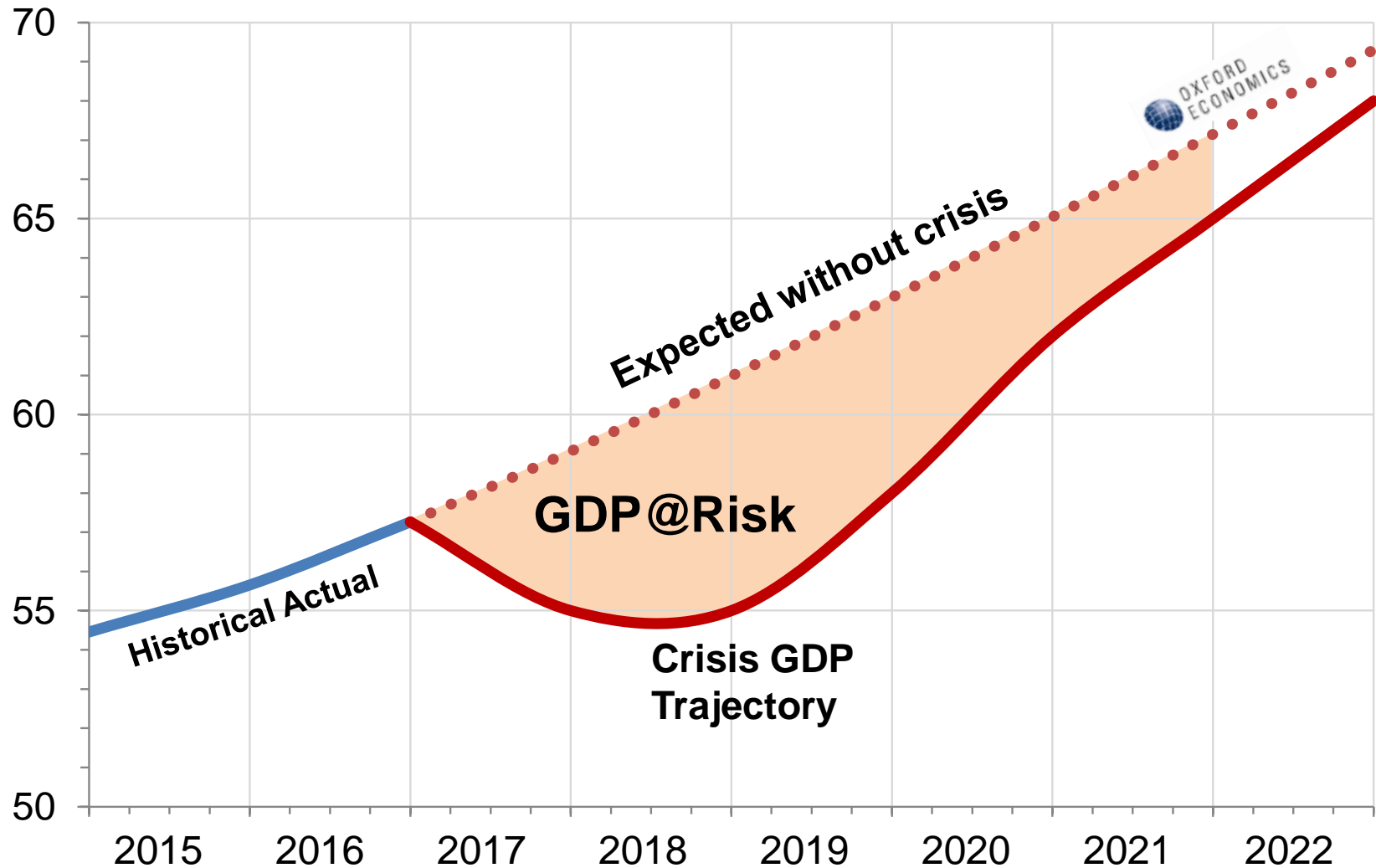


NextCat



Catastromics

GDP@Risk as a metric for comparing impacts



Comparing Single Threat Scenarios via GDP@Risk

Cambridge Single Threat Scenarios		GDP@Risk (\$Trillion)
		Standard Scenario
	Geopolitical Conflict China-Japan Conflict	17
	Asset Bubble Shock Global Property Crash	13
	Pandemic Sao Paulo Virus	7
	Sovereign Default Shock Eurozone Meltdown	11
	Food and energy price spiral High Inflation World	5
	Cyber Catastrophe Sybil Logic Bomb	5
	Social Unrest Millennial Uprising	2
	De-Americanisation of Financial System Dollar Deposed	2
2008 Great Financial Crisis		18

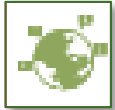
Cyber Risk Scenario and Data Schema Research

Information Technology

Loss Processes



Data Exfiltration
(‘Leakomania’)



Denial of Service Attack
(‘Mass DDoS’)



Cloud Service Provider Failure
(‘Cloud Compromise’)



Financial Theft
(‘Cyber Heist’)



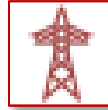
Ransomware
(‘Extortion Spree’)



Malware
(‘Sybil Logic Bomb’)

Operations Technology

Scenarios of Asset Damage



Cyber Attack on **US Power Generation**
(‘Business Blackout’) * v1.1



Cyber Attack on **UK Power Distribution**
(‘Integrated Infrastructure’)



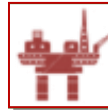
Cyber attack on **Commercial Office Buildings**
(Laptop batteries fire induction’)



Cyber attack on **Marine Cargo Port**
(‘Port Management System’)



Cyber Attack on **Industrial Chemical Plant**
(‘ICS Attack’)



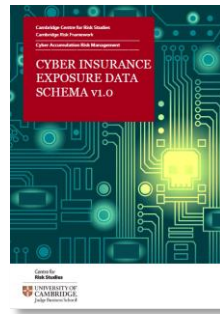
Cyber Attack on **Oil Rigs**
(‘Phishing-Triggered Explosions’)



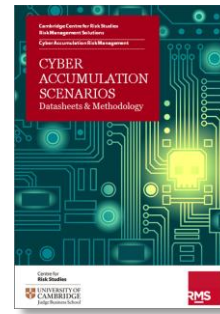
Sybil
Logic Bomb



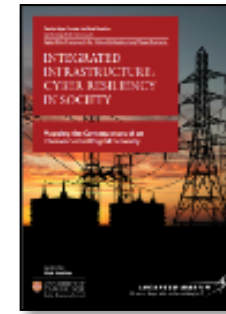
US Cyber
Blackout



Exposure Data
Schema



Accumulation
Scenarios



UK Cyber
Blackout



Cyber
Terrorism

CCRS Research Outputs: Explorations of individual threats



Taxonomy of Threats



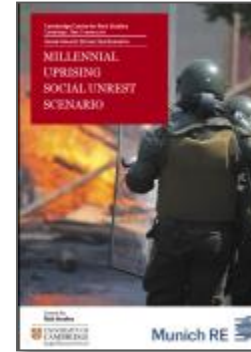
Geopolitical Conflict
Emerging Risk Scenario



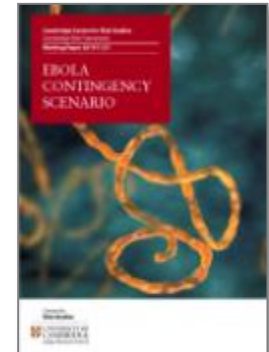
Pandemic
Emerging Risk Scenario



Cyber Catastrophe
Emerging Risk Scenario



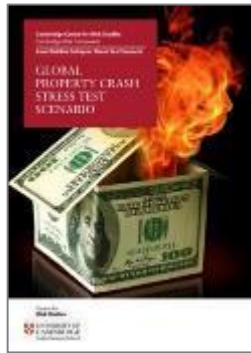
Social Unrest
Emerging Risk Scenario



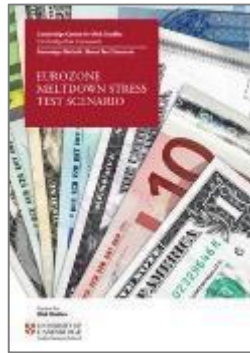
Ebola
Emerging Risk Scenario



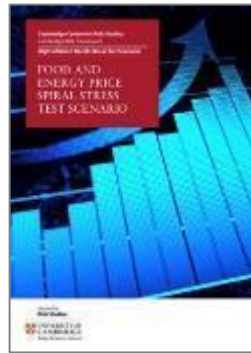
Financial Catastrophes



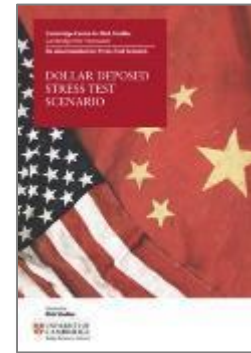
Global Property Crash
Financial Risk Scenario



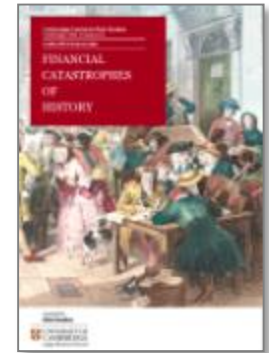
Eurozone Meltdown
Financial Risk Scenario



High Inflation
Financial Risk Scenario



Dollar Dethroned
Financial Risk Scenario



Historical Crises
Financial Risk



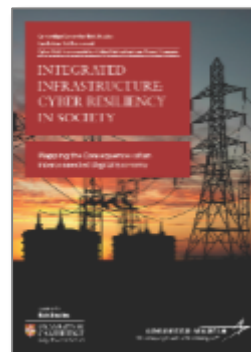
Cyber Accumulation
Insurance Risk Report



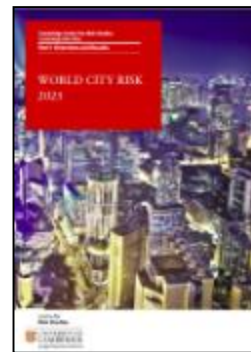
NatCat FinCats
Clash Report



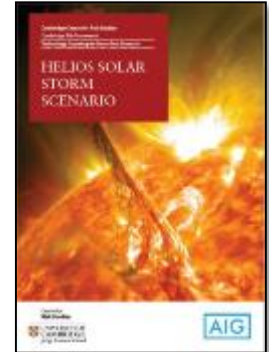
Business Blackout
Lloyds Emerging Risk Report



Infrastructure
Cyber Attack UK



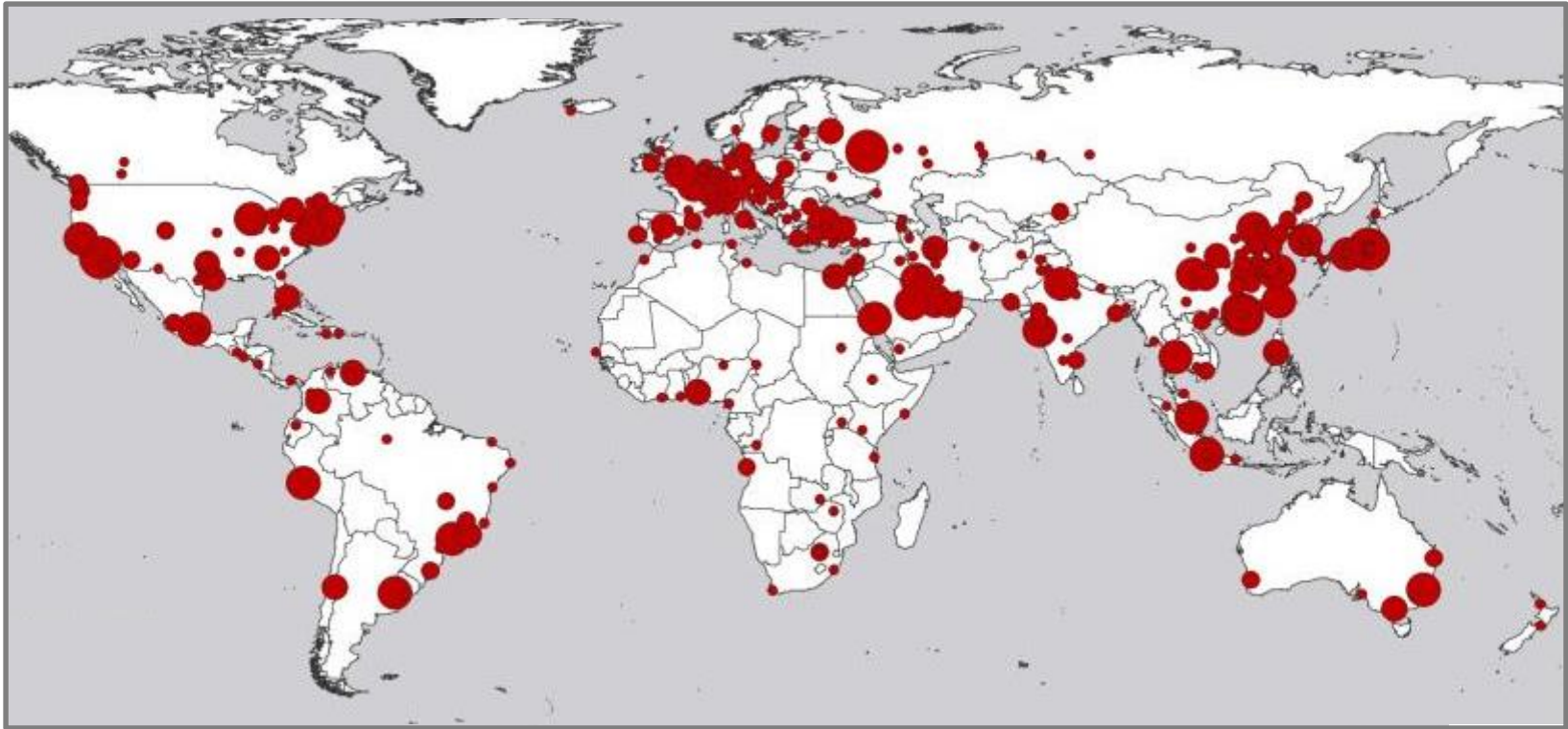
World City Risk 2025
Lloyds Co-Branded Report



Solar Storm
Emerging Risk Scenario

- Scenarios
- **Analytics – Cambridge Global Risk Index**
- Use Cases

Take 300 Cities to Represent Global Economy



We picked the 'A List' of the world's cities for this analysis, which:

- Are responsible for **half** of the World's GDP today
- Will be responsible for **two-thirds** of the World's GDP in **2025**
- Are the largest cities in the 50 largest economies in the world
 - Top 25 cities in US (#1 economy) and top 32 cities in China (#2 economy)
 - Between 5 and 12 top cities for each of the rest of the top 17 economies
- Include all cities over 3m population in the world
- Consist of half of the world's capital cities

Take 22 Threats as “Universe of Threats” to Global Economy

Finance, Economics and Trade



Market
Crash



Sovereign
Crisis



Commodity
Prices

Geopolitics and Security



Interstate
Conflict



Terrorism



Separatism
Conflict



Social
Unrest

Natural Catastrophe and Climate



Earthquake



Tropical
Windstorm



Temperate
Windstorm



Tsunami



Flood



Volcanic
Eruption



Drought



Freeze



Heatwave

Technology and Space



Nuclear
Accident



Power
Outage



Cyber
Attack



Solar
Storm

Health and Humanity

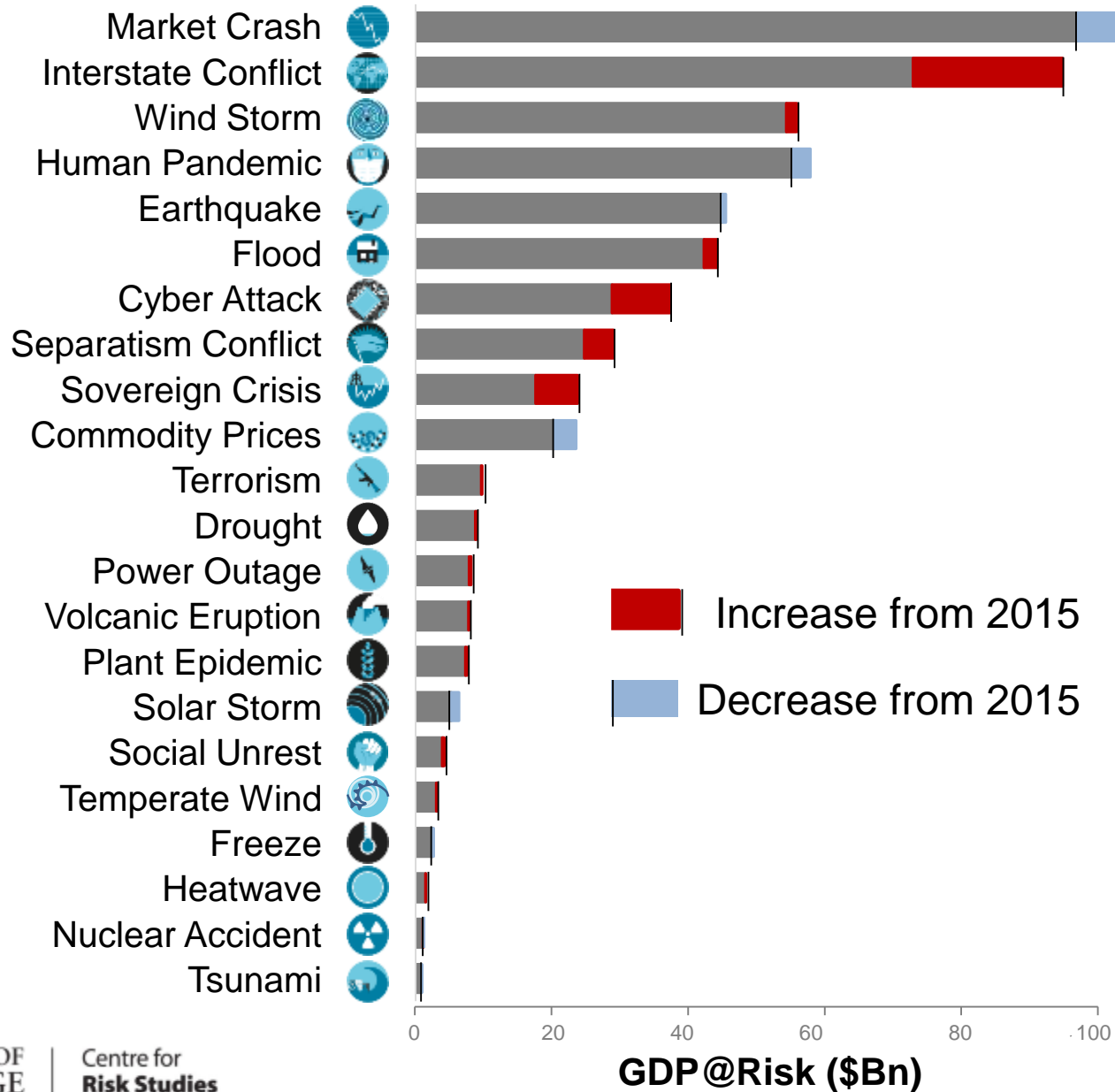


Human
Pandemic

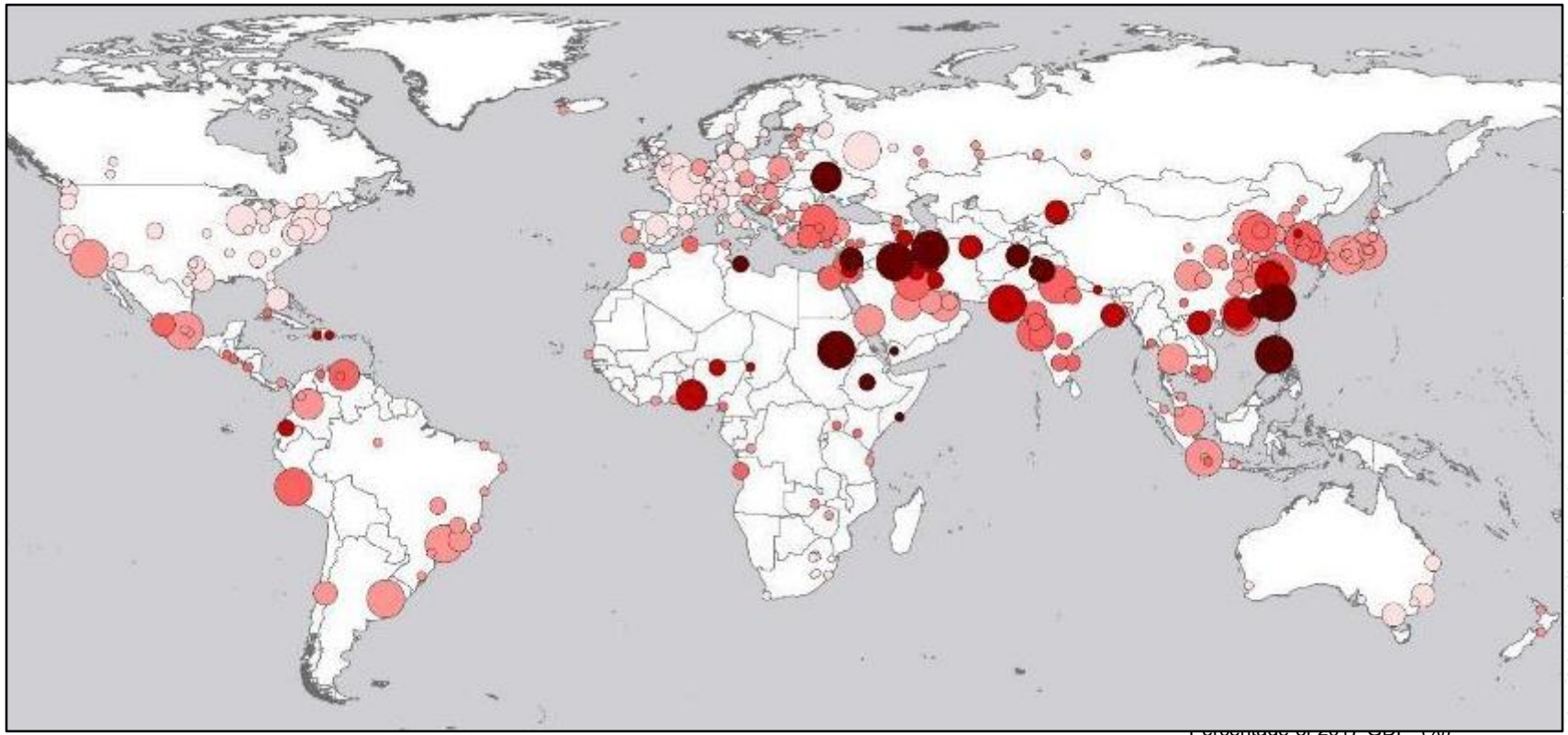


Plant
Epidemic

Cambridge Global Risk Index 2017: Update by Threat



Cambridge Global Risk Index 2017



Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Percentage of 2017 GDP (%)

City GDP@Risk
2017 10yr Risk Outlook (\$Bn)

- 0.03 to 1
- 1 to 2.5
- 2.5 to 5
- 5 to 10
- 10 to 21 Bn

As % of Annual GDP
Using 2017 GDP

- 0 to 1%
- 1% to 2%
- 2% to 3.5%
- 3.5% to 5%
- 5% to 13%

Cambridge Global Risk Index 2017

Baseline Long Term 10yr Risk Outlook

2017 to 2026 10yr Risk Outlook

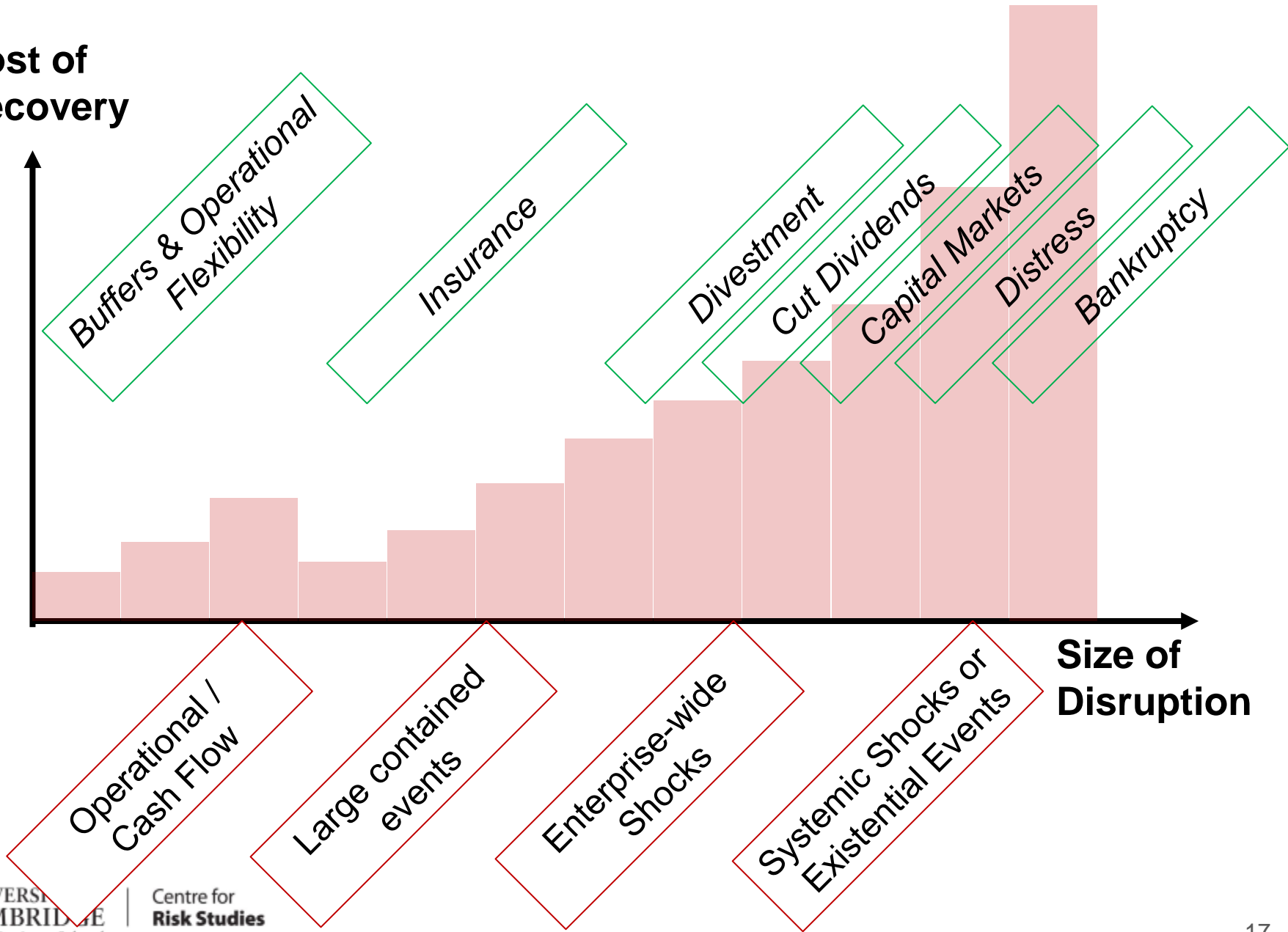
GDP@Risk: Probability-weighted expected annual loss in economic output from disruptive shocks from 22 threat categories for 300 leading cities of the world.

GDP@Risk as a % of city's annual GDP economic output

- Scenarios
- Analytics
- **Use Cases – Corporate and Insurance**

Use Cases Around Tail Risks and Top Risks

Cost of Recovery



“Recurring damage from non-recurring events”

Take 22 categories of threats

How often does your organisation experience

- a dividend threatening event?
- a downgrade to your credit rating?
- ... or worse?



A trillion dollar global economic shock every 8 years !!

Developing Business Ready Tools: “Use Cases”

A major innovation of Centre for Risk Studies has been to standardise shock assessment

- Quantify GDP@Risk using Cambridge Global Risk Index

We are refining risk metrics for use cases:

- “Corporate Risk Profiling” for quantifying balance sheet risk

- ⇒ “Assets@Risk” for manufacturing and finance

- ⇒ “Revenue@Risk” for disruption of markets

- Insurance & Finance

- ⇒ “Insurance@Risk” for probable maximal loss

- ⇒ “Underwriting@Risk” for (new) insurance products

- ⇒ “Investments@Risk” for financial portfolios

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