Putting it all Together: Project Pandora

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Trillion Dollar Catastrophe Scenarios

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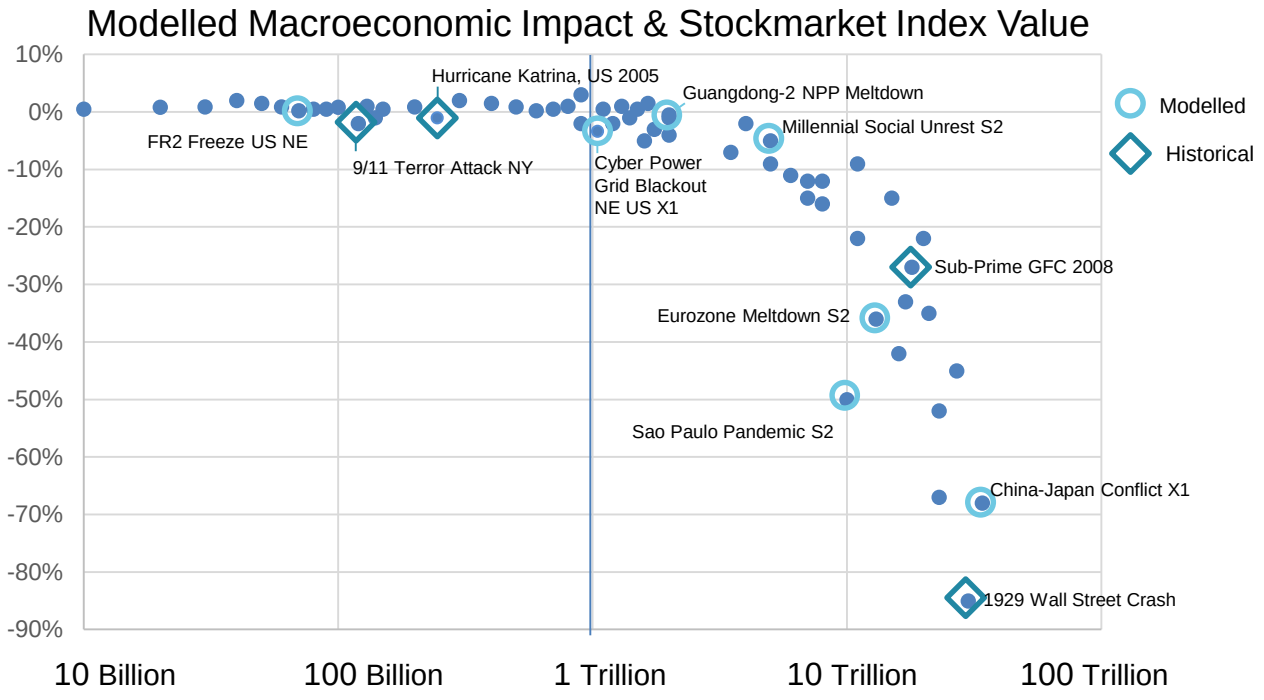
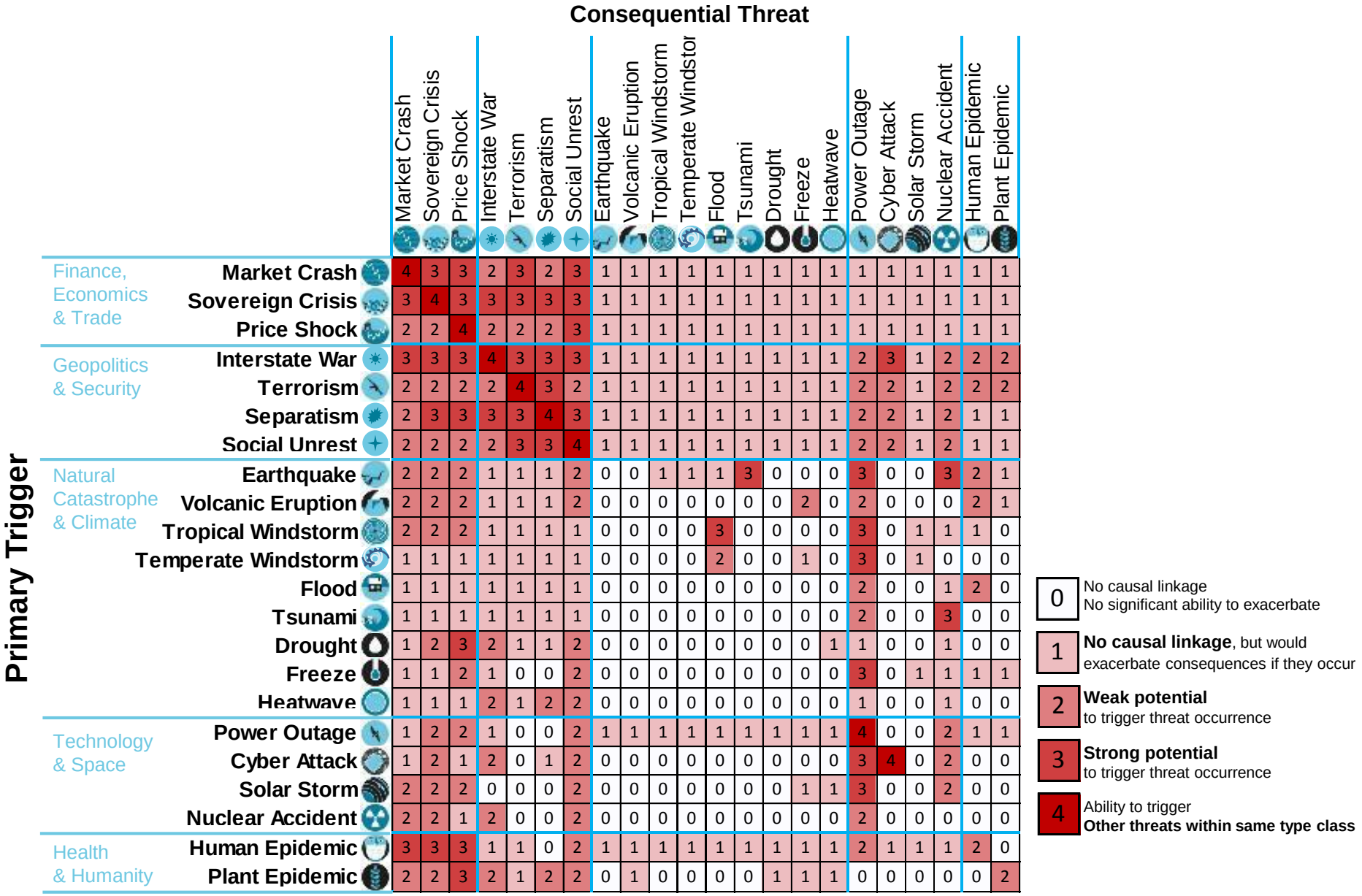
Defining ALL the Trillion Dollar Event Scenarios

- The economy is relatively robust to minor and localized shocks
- A shock that destroys **a trillion dollars or more** of economic output is sufficiently large to trigger significant stockmarket equity devaluations
  - It becomes systemic and impacts connections and wider scale relationships
- Our objective to define all the likely causes of trillion dollar shocks to the global economy in a scenario event set

Stockmarket Shock
Reduction of S&P500 Index in One Quarter

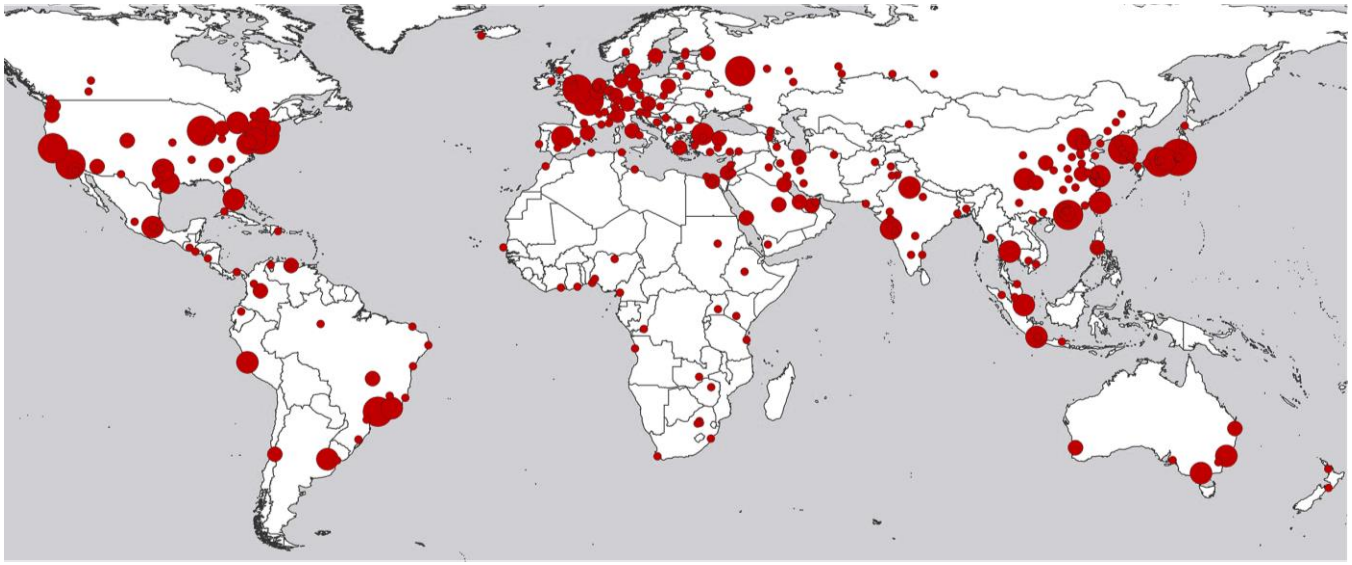


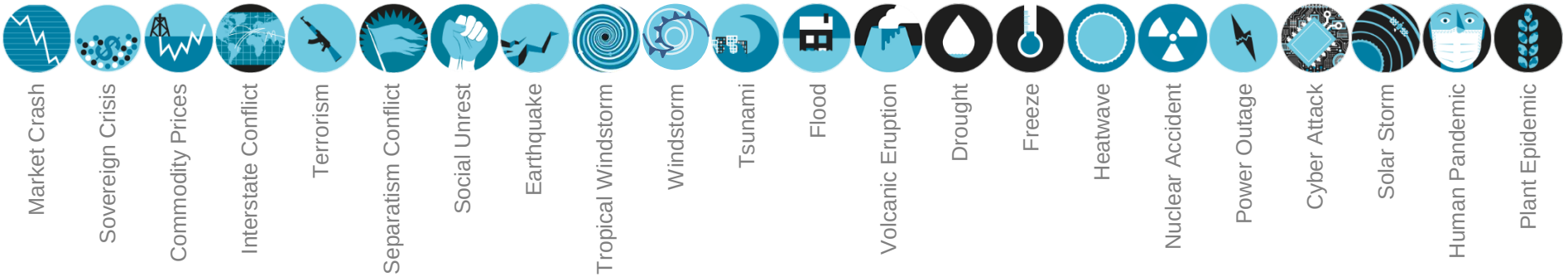
How One Shock Might Cascade into Another



Cambridge Global Risk Index

300 Cities
22 Threats





- For each threat and each city we model the effects of Local Impact Severities (LIS):
- Estimated loss to the GDP economic output of each city from 3 levels of severity

Subject Matter Specialists and Collaborators

Finance, Economics & Trade

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Dr. Kimmo Soramaki, *CEO*

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Natural Catastrophe & Climate

Risk Management Solutions Inc.

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Technology & Space

Cambridge Computer Labs CyberCrime Centre
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Dr. Claire Souch, *Product Manager*

A Scenario is Defined By…

Interstate Conflict Scenario: **IC04**
Name: **Saudi Arabia & Iran**
Description: **Bilateral border conflict between two medium powers**

		Local Impact Severities ($US bn)		
		IC1 (small) City mobilized for war, but not attacked; mobilization switches civilian commerce to military production; population gripped by fear, consumer demand drops, parts of population flees. Investor confidence is affected; Conflict lasts a year.	**IC2 (medium)** City suffers sporadic attack from occasional missiles or aerial bombardment, possible damage to city infrastructure from military cyber attack; City is mobilized for war; significant emigration of population from city. Investors withdraw	**IC3 (large)** City is the target of strategic bombing by enemy forces, destroying industrial and commercial output and military facilities in the city; Major emigration by population. Possible rebuilding afterwards by major injection of capital. Conflict lasts 3 years.
CRS City ID	**City Name**			
SAU_ARI	Riyadh	43.6	**224.6**	391.8
SAU_JED	Jeddah	42.4	**218.6**	381.0
IRN_TER	Tehran	29.2	167.4	**296.4**
IRN_KHR	Mashhad	9.3	**53.8**	95.0
IRN_ISF	Isfahan	6.2	**35.9**	63.4
IRN_34807	Karaj	**5.4**	31.4	55.4
IRN_AEK	Tabriz	5.4	31.2	**55.0**
IRN_FAR	Shiraz	4.7	27.4	**48.3**
IRN_KHZ	Ahvaz	3.8	**21.8**	38.4
IRN_QOM	Qom	**3.7**	21.5	37.8
IRN_38338	Kermanshah	3.0	**17.6**	31.0

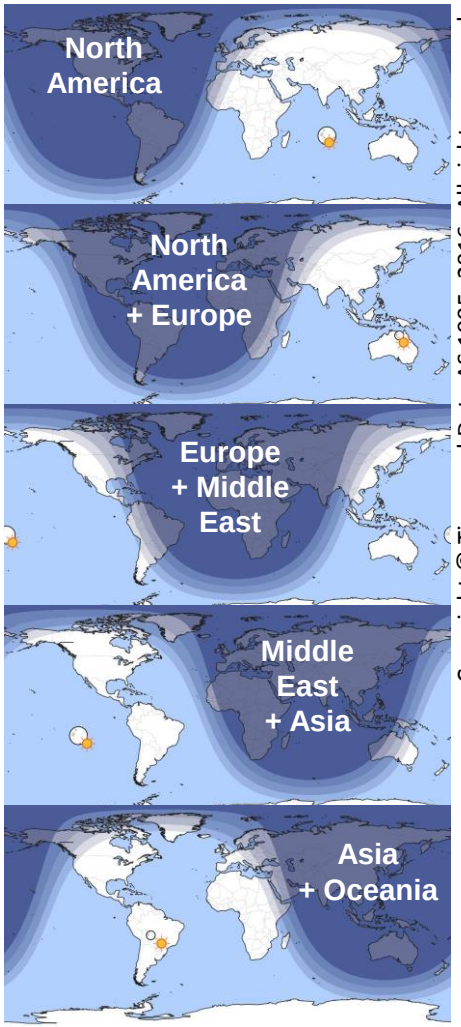
Total GDP@Risk ($US bn)	**1,009**
Estimated Return Period	**600**

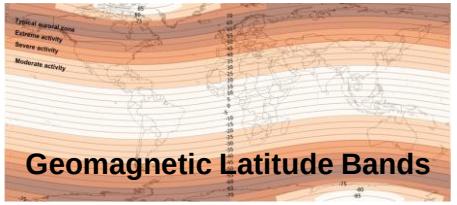
How do we Devise the Scenarios?

		ID	Threat	Phase	Hazard Map	Severity Scale	Cause	Projection	Uncertainty
Natural Catastrophe & Climate									
	1.1	EQ	**Earthquake**	1	United States Geological Survey; GSHAP	Ms (Surface-wave Magnitude)	Natural	Constant	Low
	1.2	VE	**Volcanic Eruption**	1	Smithsonian Institute of Volcanology	VEI (Volcanic Explosiivity Index)	Natural	Constant	Medium
	1.3	HU	**Tropical Windstorm**	2	EM-DAT; Pacific Research Center; Munich Re	Saffir-Simpson CAT Hurricane Scale	Natural	CC Trend	Low
	1.4	WS	**Temperate Windstorm**	2	EM-DAT Windstorm Database	Beaufort Wind Scale	Natural	CC Trend	Low
	1.5	FL	**Flood**	1&2	UNEP/DEWA/GRID-Europe Flood Risk Rating	Depth and velocity of flood water	Natural	CC Trend	Low
	1.7	TS	**Tsunami**	2	NOAA NCDC Historical Tsunami Database	Run-up height	Natural	CC Trend	Medium
	1.8	DR	**Drought**	2	US National Center for Atmospheric Research	Palmer Drought Severity Scale	Natural	CC Trend	Medium
	1.10	FR	**Freeze**	2	Global Climate Zoning Map	Degree-Days below 0C	Natural	CC Trend	Medium
	1.11	HW	**Heatwave**	2	Global Climate Zoning Map	Degree-Days Above 32C	Natural	CC Trend	Medium
Financial, Trade & Business									
	2.1	MC	**Market Crash**	1	IMF Banking Network Core-Periphery Designation	S&P500 Index reduction	Man-Made	Dynamic	High
	2.2	SD	**Sovereign Crisis**	1	S&P National Credit Ratings	% Devaluation of national currency	Man-Made	Dynamic	Medium
	2.3	OP	**Commodity Prices**	2	UN imported oil intensity of GDP output	% increase in oil price (Brent Crude)	Man-Made	Dynamic	Medium
Political, Crime & Security									
	3.1	IW	**Interstate Conflict**	1	Cytora Interstate Conflict Scenario Set	War Magnitude Scale	Man-Made	Dynamic	High
	3.2	SP	**Separatism Conflict**	1	Encyclopedia of Modern Separatist Movements	Civil War Intensity (deaths)	Man-Made	Dynamic	Medium
	3.3	TR	**Terrorism**	1	IEP START Global Terrorism Index	Terrorism Severity Scale	Man-Made	Dynamic	Medium
	3.4	SU	**Social Unrest**	2	Cytora Social Unrest Event Index	Social Unrest Severity Scale		Dynamic	Medium
Technology & Space									
	4.1	PO	**Power Outage**	2	Nation Master Electrical Outage Report	City-Days of Outage	Man-Made	Constant	Medium
	4.2	CY	**Cyber Attack**	1	McAfee International Cyber Risk Report	Cyber Magnitude & Revenue@Risk	Man-Made	Dynamic	High
	4.3	SS	**Solar Storm**	2	US National Oceanic and Atmospheric Administration	US NOAA Space Weather Scale	Natural	Constant	High
	4.4	NP	**Nuclear Accident**	2	World Nuclear Association Information Library	Intntl Nuclear Events Scale (INES)	Man-Made	Constant	Low
Health & Environmental									
	5.1	HE	**Human Pandemic**	1	Emerging Infectious Diseases, Institute of Zoology	US CDC Pandemic Severity Index	Natural	Dynamic	Medium
	5.2	PE	**Plant Epidemic**	2	Wallingford Distribution Maps of Plant Diseases	Staple Crop (Wheat) Price Index	Natural	Dynamic	Medium

Solar Storm Scenarios

- Solar storms can hit different regions on the night side of Earth with different severity levels
  - Storms consist of charged particles from a Coronal Mass Ejection being accelerated towards Earth
  - Primary impacts are widespread blackouts caused by disruption to electricity network assets
- We consider five discrete ‘night shadows’ and six geomagnetic latitude bands
- Storm scenarios consider, for each of the night shadows, different severity levels at each geomagnetic latitude band
- We infer from historical events the likelihood of a storm impacting a geomagnetic latitude at a given severity level
  - Overall scenario probabilities are then estimated from bottom-up city-level probabilities

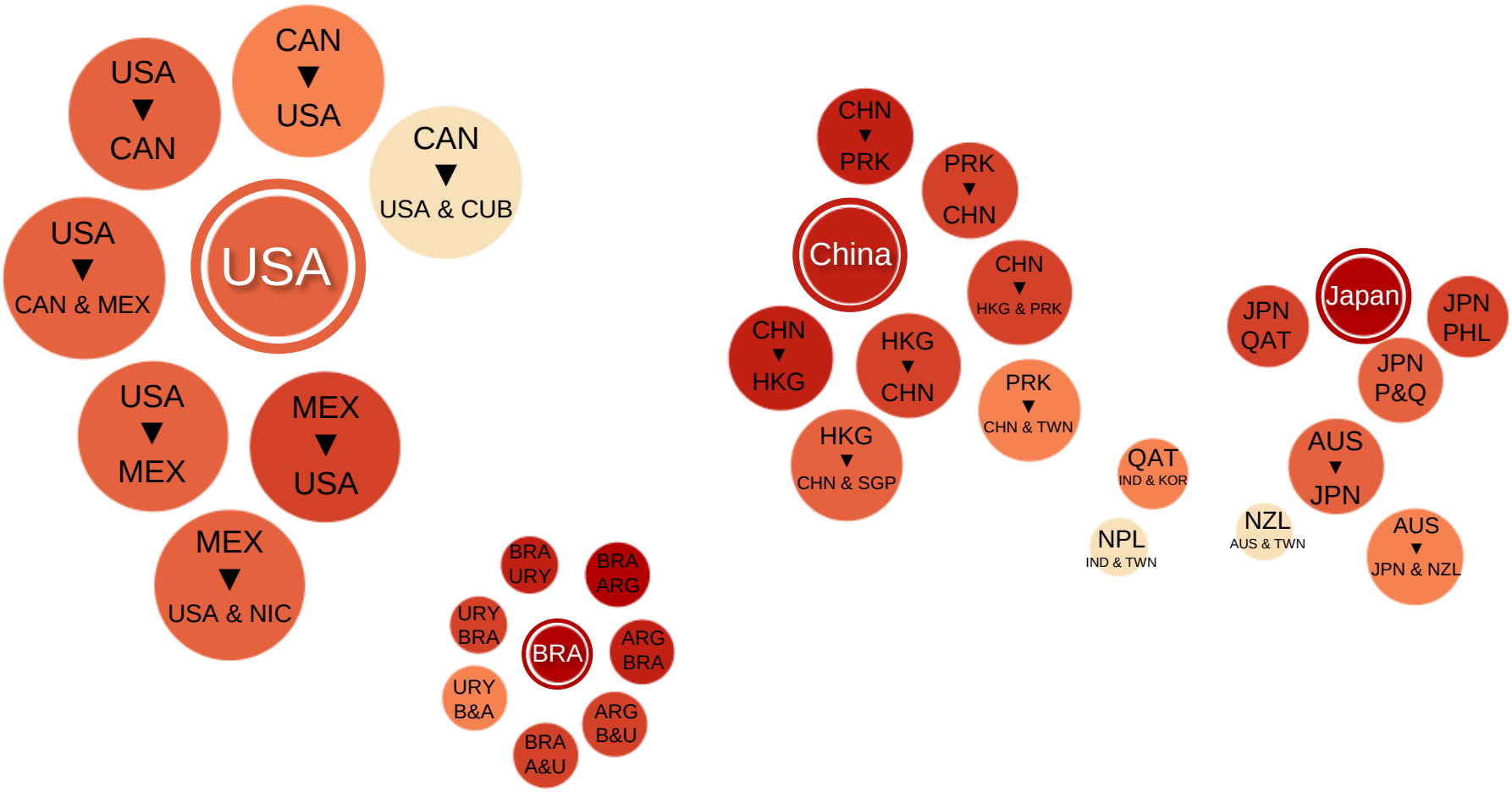




Sovereign Crisis Scenarios

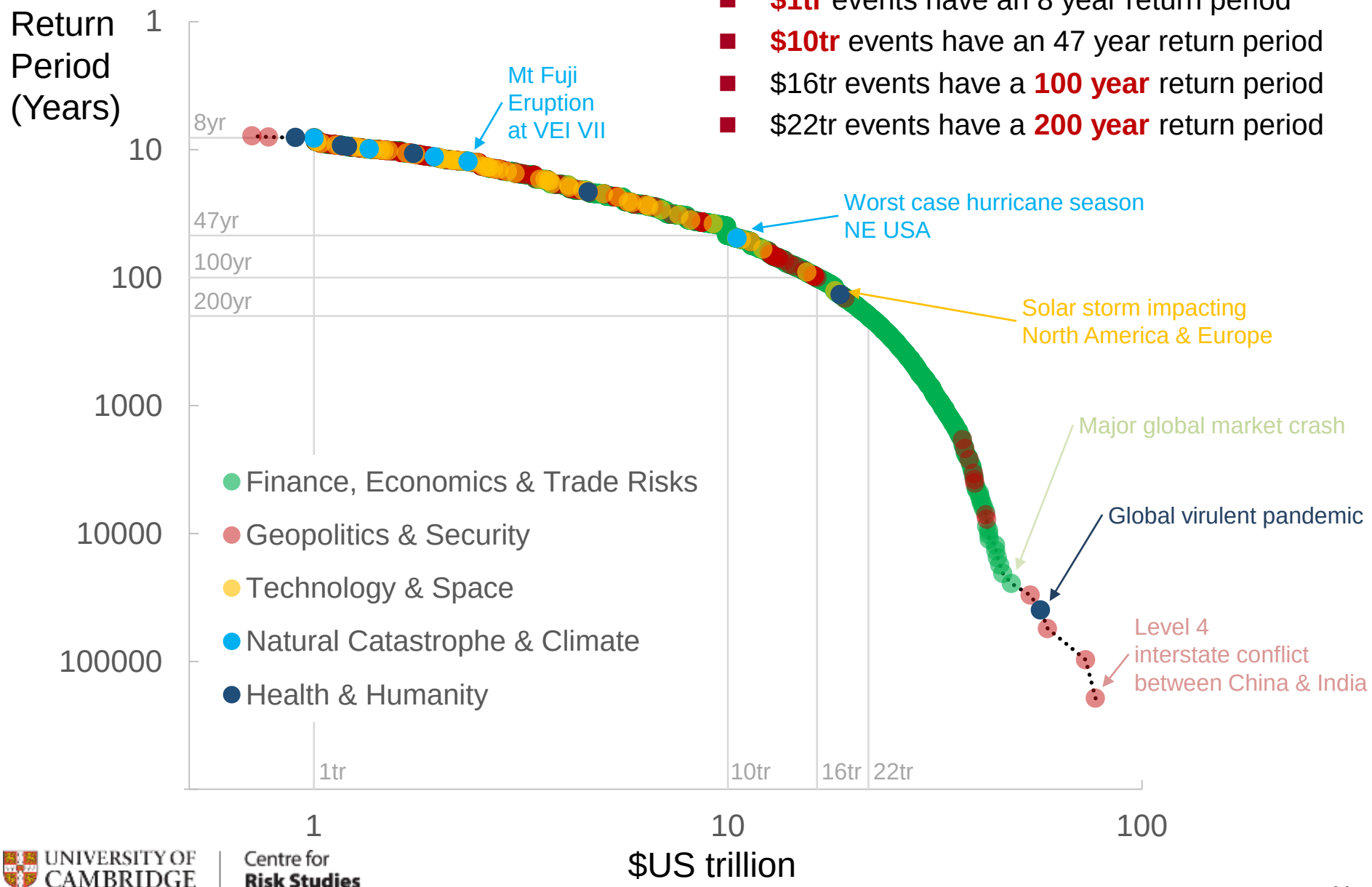
- Scenarios are defined at a country-level
  - All cities within an affected country are assigned the same LIS severity level
- We first define a set of scenarios that consist of a single sovereign crisis
  - 5 year CDS spreads are used to estimate annual probability of crisis
  - E.g., Brazil is estimated to have a 3-4% annual chance of a sovereign crisis
- The UN Comtrade trade network is used to identify countries that could fall into crisis as a consequence of another country being in crisis
  - The probability of a cascading crisis is affected by the strength of bilateral trading relationships
  - E.g., a Brazilian crisis could trigger a crisis in Argentina
- Another set of scenarios then define double and triple sovereign crisis cascades

Sovereign Crisis Scenarios

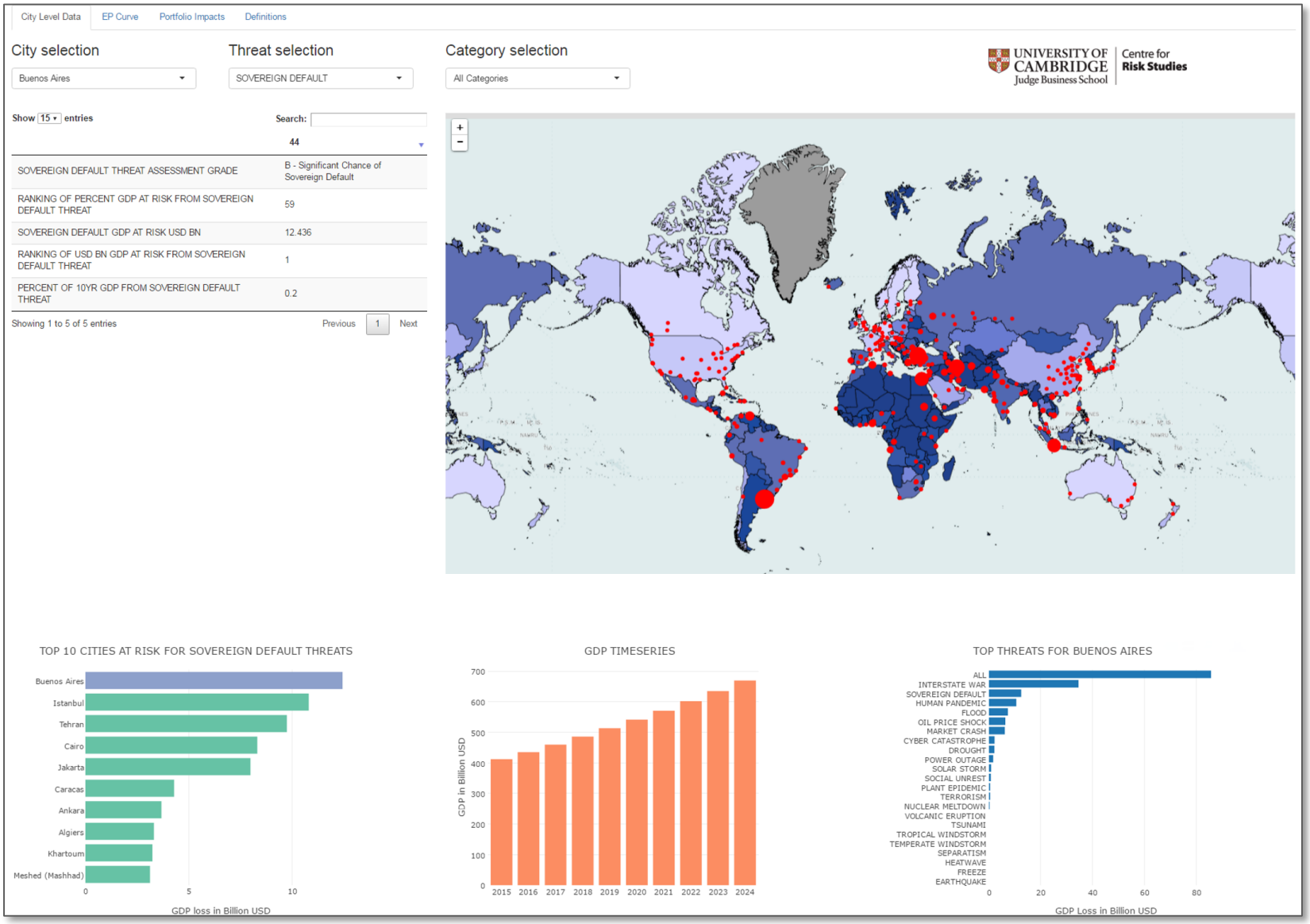


Global Catastrophe Exceedance Probability Curve

- **$1tr** events have an 8 year return period
- **$10tr** events have an 47 year return period
- $16tr events have a **100 year** return period
- $22tr events have a **200 year** return period



Cambridge Global Risk Platform



Dashboard developed in RStudio Shiny accessing data from Cambridge Global Risk Model via REST API

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