Institute and Faculty of Actuaries

Climate Scorpion

The Sting is in the Tail

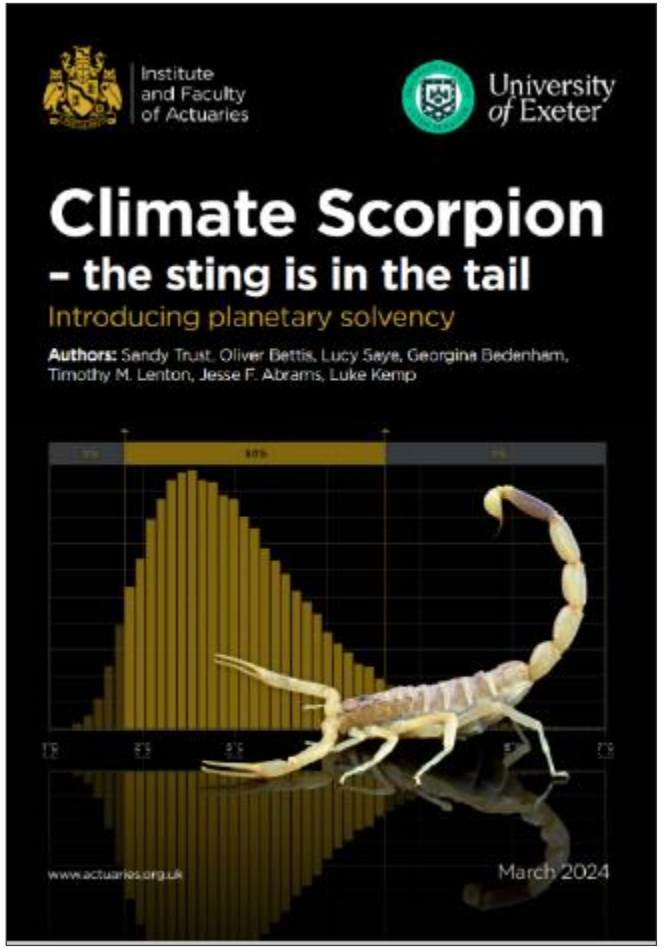
Boston IMAP

Sandy Trust

September 2024

Standby - incoming Climate Scorpion

- The Actuarial Approach to Climate Risk.
- IFOA Collaboration with Earth System Scientists.
- Shifting Distributions.
- Life in the Tail.
- The Sting – Equilibrium Climate Sensitivity and Tipping Points
- Realistic Risk Assessment, more Tipping Points
- Planetary Solvency



Institute and Faculty of Actuaries

An Actuarial Approach to Climate Risk

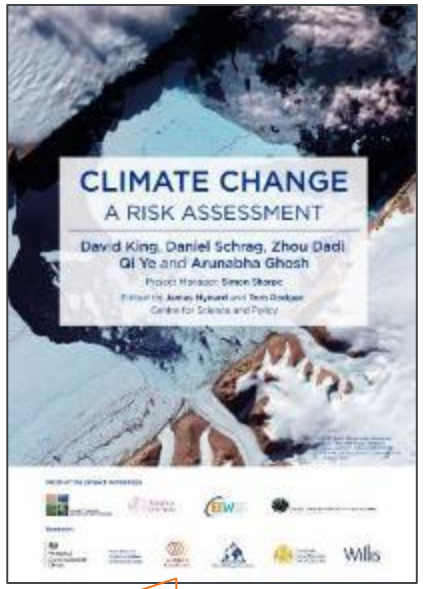
> **We need to have a best guess about the worst-case and make policy on that basis…**

Institute and Faculty of Actuaries

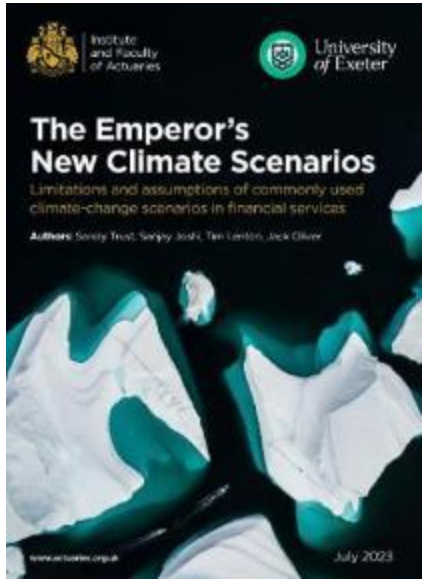
IFOA collaboration with Earth System scientists

2015 — 2022 — 2023 — 2024

Today

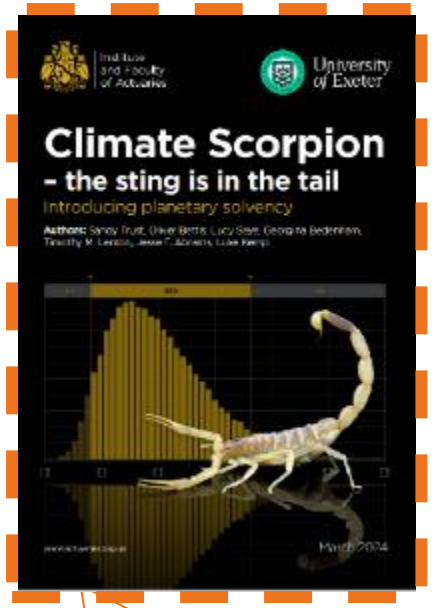


First global risk assessment of climate change, UK led with US, China and India. IFOA participated with input in particular from David Hare (then President) and Trevor Maynard (Lloyds of London).



Climate change is a risk management problem– one of the most important goals of climate change policy should be to limit the probability of a very bad outcome to an acceptably small value.

Many climate-scenario models in financial services are significantly underestimating climate risk…Real-world impacts of climate change are largely excluded from the damage functions of public reference climate-change economic models.



The Earth's climate may be more sensitive than we thought….time for Planetary Solvency

Institute and Faculty of Actuaries

Links to IFOA reports: climate-emergency-final-report.pdf (actuaries.org.uk) ; the-emperor-s-new-climate-scenarios_ifoa_23.pdf (actuaries.org.uk)

But why do we need actuaries to work with scientists?

Science

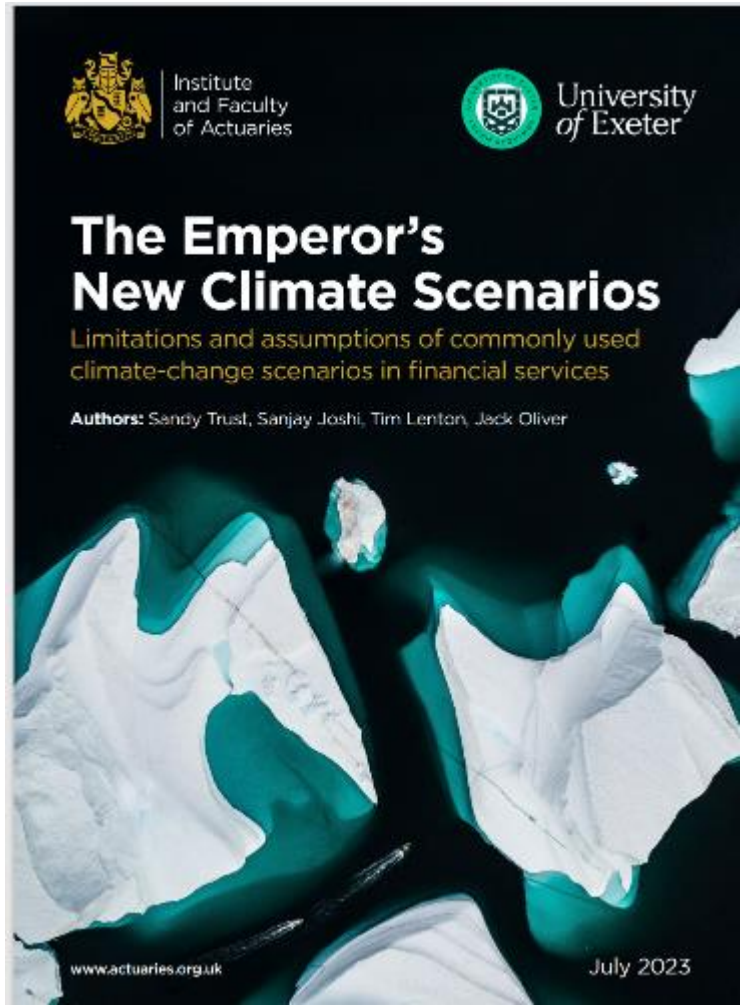
- We should not say there is an iceberg until we are fully confident there is one present
- Concerned with making predictions
- Which informs economists
- Which informs policy

Risk

- There could be an iceberg, so we should typically steer well clear of it
- Concerned with ‘what is the worst that could happen’
- This is no-one’s job…
- Could the actuarial profession play a role?

Institute and Faculty of Actuaries

Emperor's New Climate Scenarios



University of Exeter

Climate models are understating risk

Institute and Faculty of Actuaries

Why don't these results make sense?

Sample TCFD results from UK investors, impact on portfolio returns per annum, long term

Institution	Orderly	Disorderly	Hot House
Institution 1	-0.2%	-0.2%	-0.1%
Institution 2	-0.1%		-0.1%
Institution 3	-0.1%		-1.0%
Institution 4	0.7%		-0.5%
Institution 5	-0.1%	-0.5%	-0.4%
Institution 6	0.0%		-0.2%

"benign results for the hot-house world are deeply flawed and underestimate the impact of the risks we expect to face"

Institute and Faculty of Actuaries

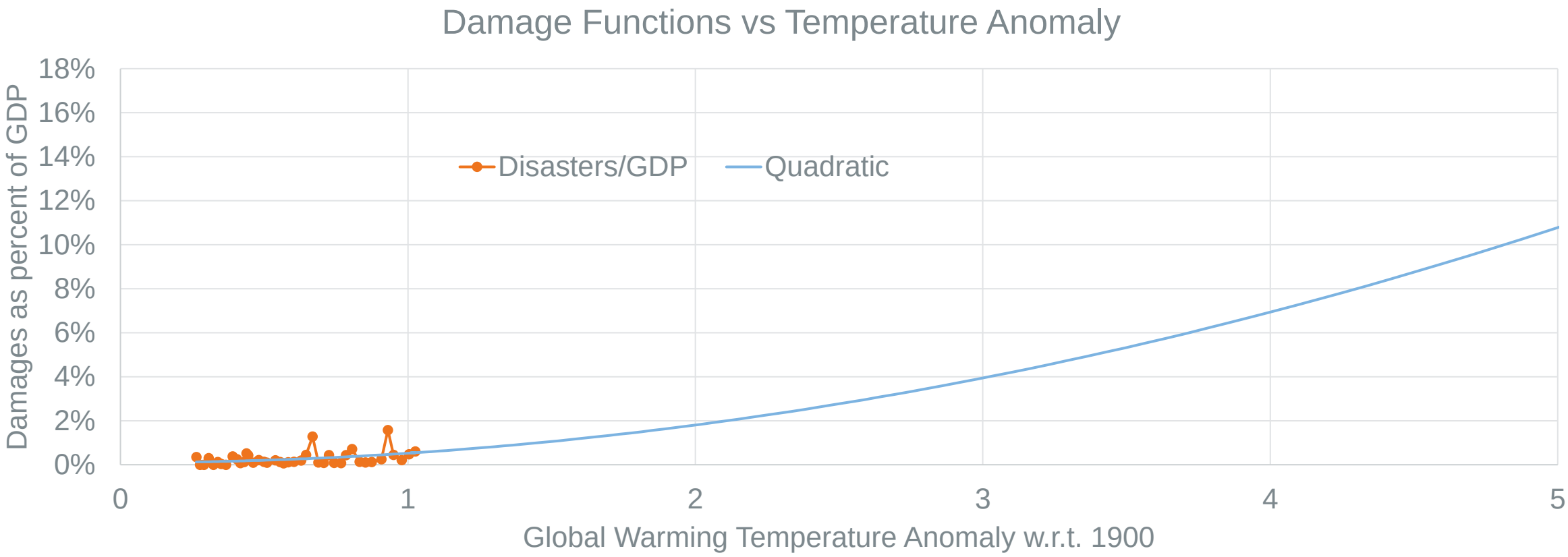
Economists have estimated the economic losses from climate change in a hot-house scenario to be *"as low as 2.1% of global economic production for a 3˚C rise in global average surface temperature, and 7.9% for a 6˚C rise."*

How?

- A striking disconnect between climate science and economics
- Models exclude many of the risks we expect to face, such as tipping points, sea level rise or involuntary mass migration.
- Estimates exclude sectors of the economy that work inside, 87% of economy
- General equilibrium models have a number of underpinning assumptions that do not hold
- So modelling 'what happened in the past when it became a little warmer'
- With impacts restricted to a small proportion of the economy

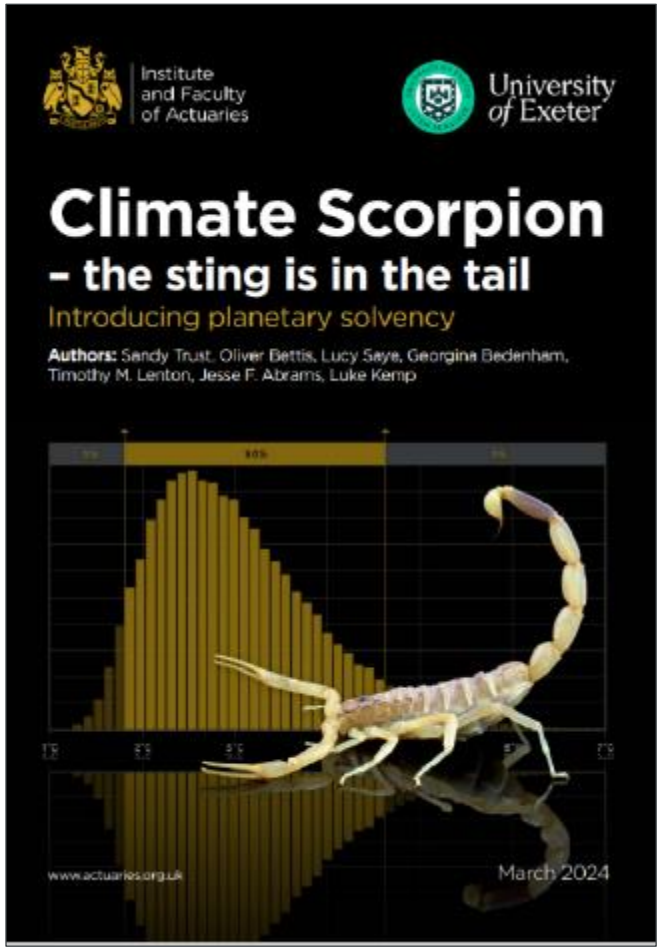
Institute and Faculty of Actuaries

Meaning no amount of global warming impacts GDP…



Institute and Faculty of Actuaries

Climate Scorpion – Key Findings



1. **The rate of global warming accelerated in 2023, there is early indication this is not temporary.**

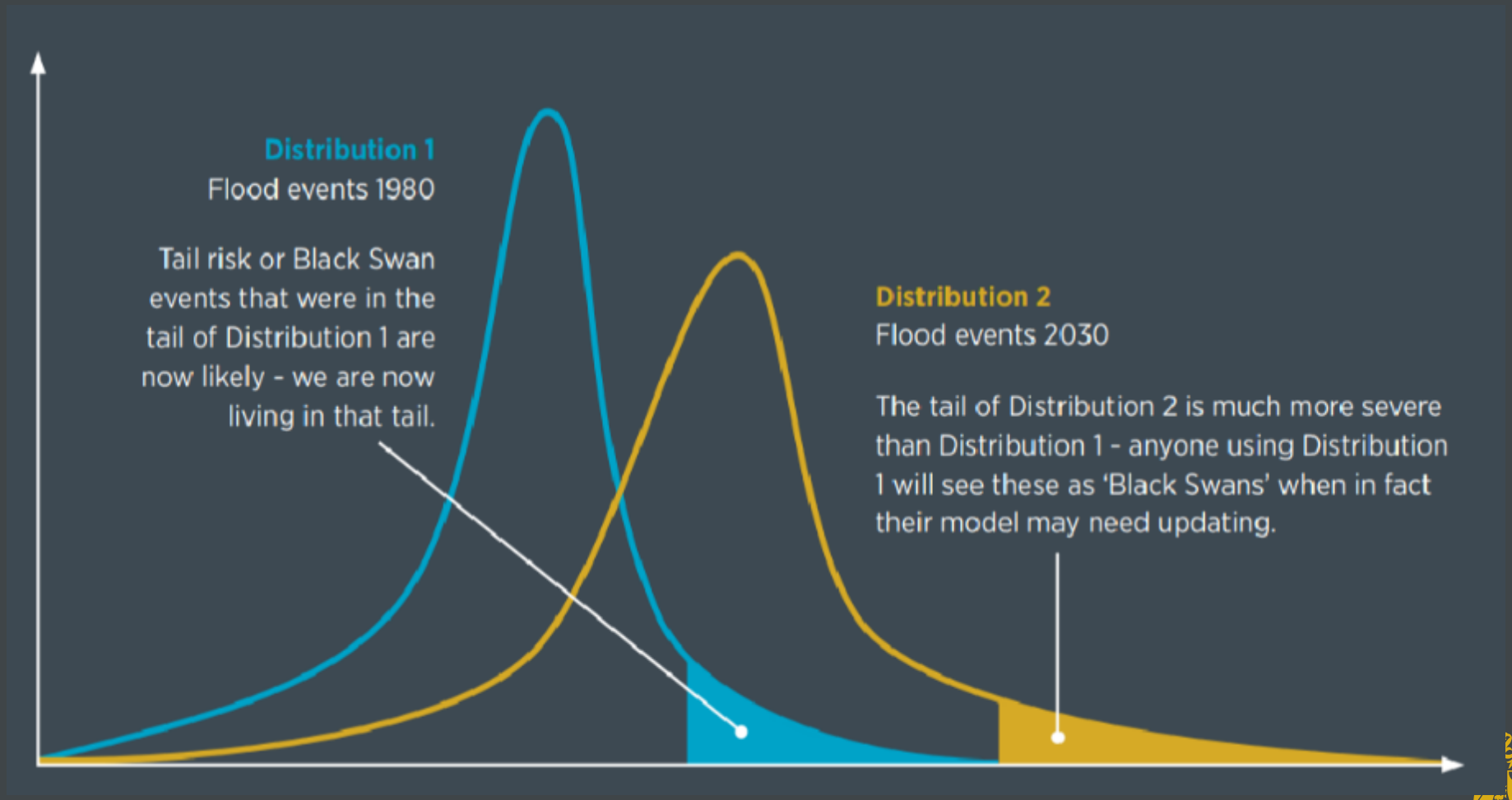
2. **Life in the tail - increased warming is now driving more severe impacts across the planet .**

3. **An overshoot of the 1.5°C temperature threshold is likely.**

4. **The sting in the tail of the Earth's climate sensitivity.**

5. **Warming above 1.5°C is dangerous, increasing the risk of triggering multiple climate tipping points.**

Tail risk and shifting distributions



Institute and Faculty of Actuaries

Distributions illustrative, not based on flood data

Earth's climate may be more sensitive than we thought

A planetary cooking experiment with global consequences…

1. Greenhouse gas levels are the hand on the temperature setting

3. Equilibrium Climate Sensitivity (ECS) is the temperature gauge

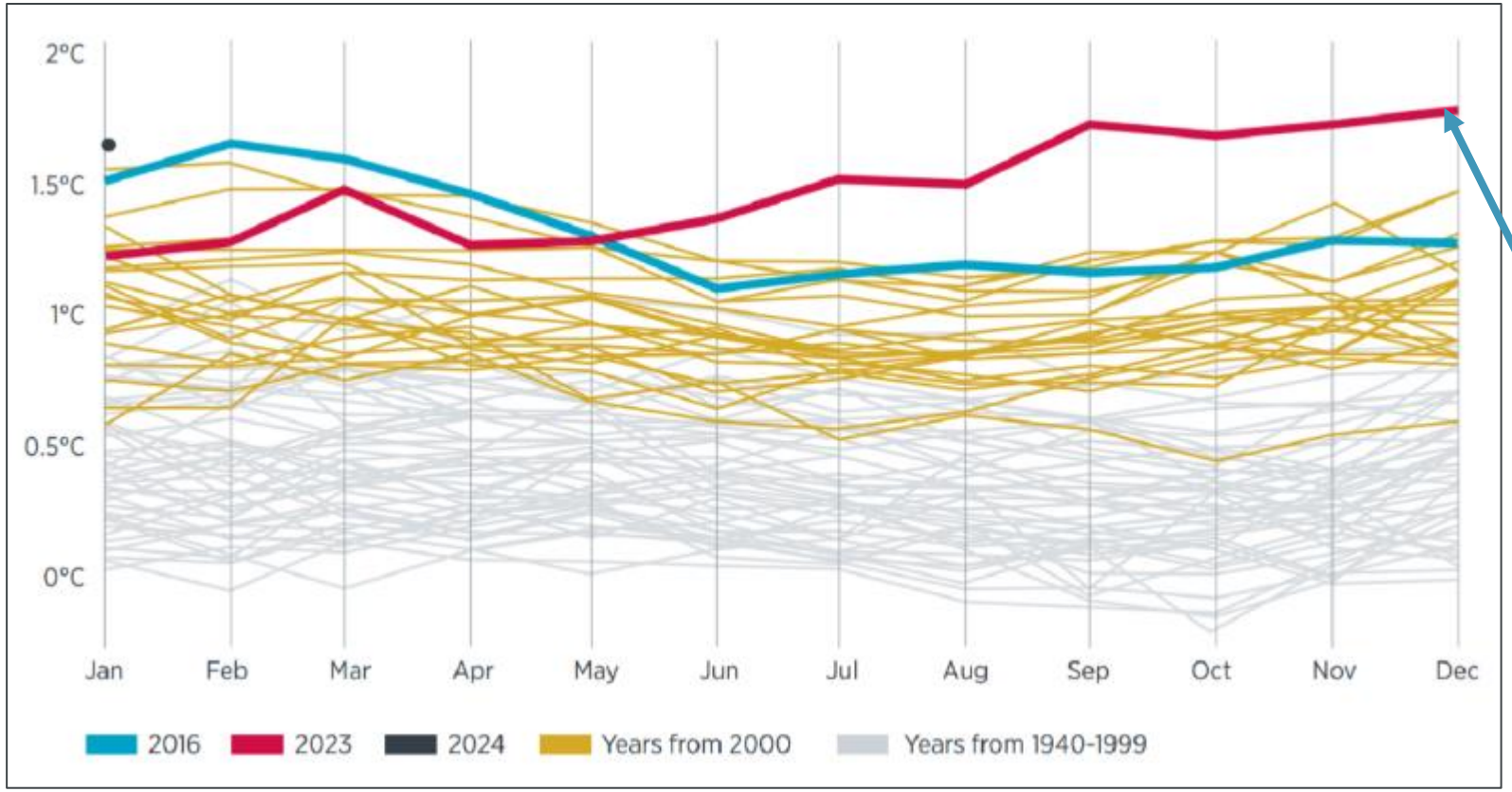
2. Earth's Energy Imbalance is the current

4. Carbon budgets are the timer

Institute and Faculty of Actuaries

The rate of global warming accelerated in 2023

Global Surface Air Temperature Anomalies



The last 9 months (to February) have consistently set temperature records for hottest month on record. Sea surface temperatures have set daily records for over a year.

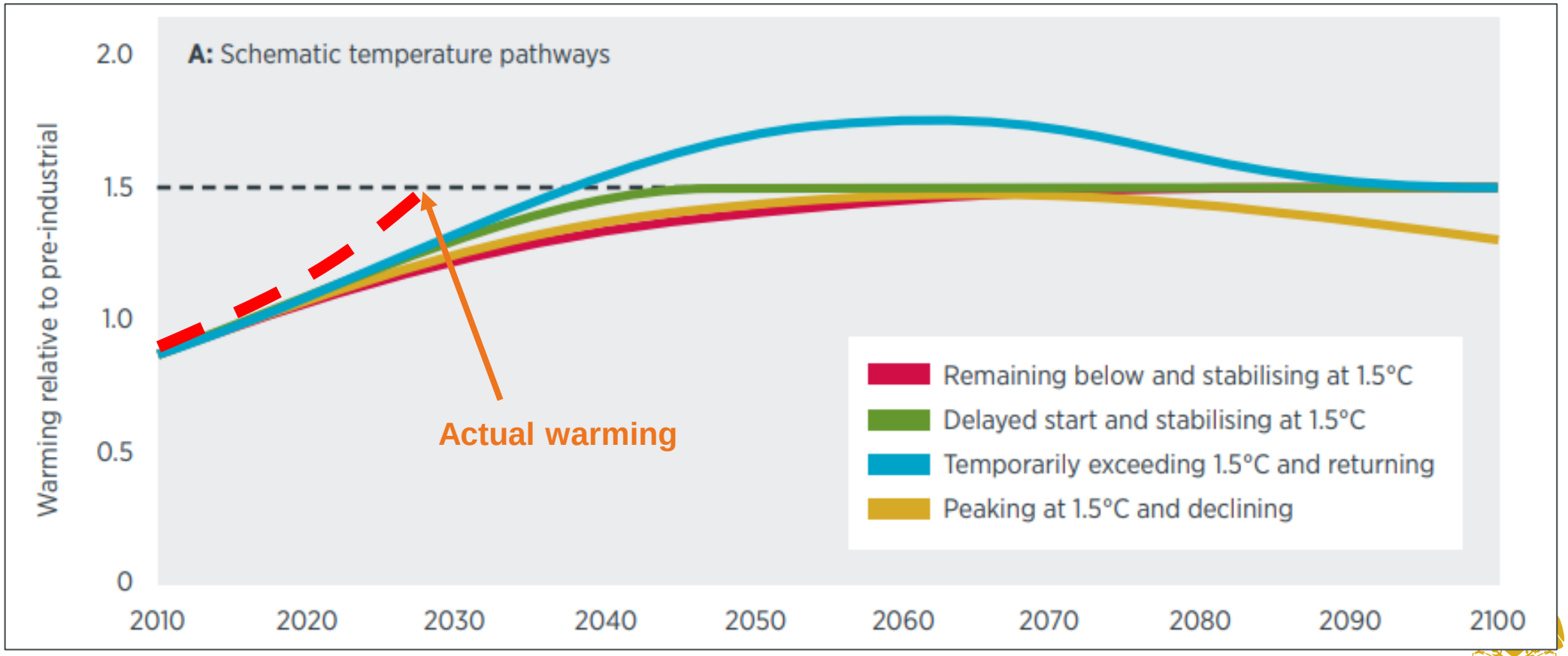
2023 temperatures are shown by the red line. Notice the jump up in temperature over the 2nd half of 2023, with temperatures near the 1.75°C mark.

Institute and Faculty of Actuaries

Sources: *IFoA analysis, Data ERA5 1940-2024, Reference period: 1850-1900, Source: climate.copernicus.eu*

Increasing the chance of overshoot

IPCC Schematic of Temperature Pathways

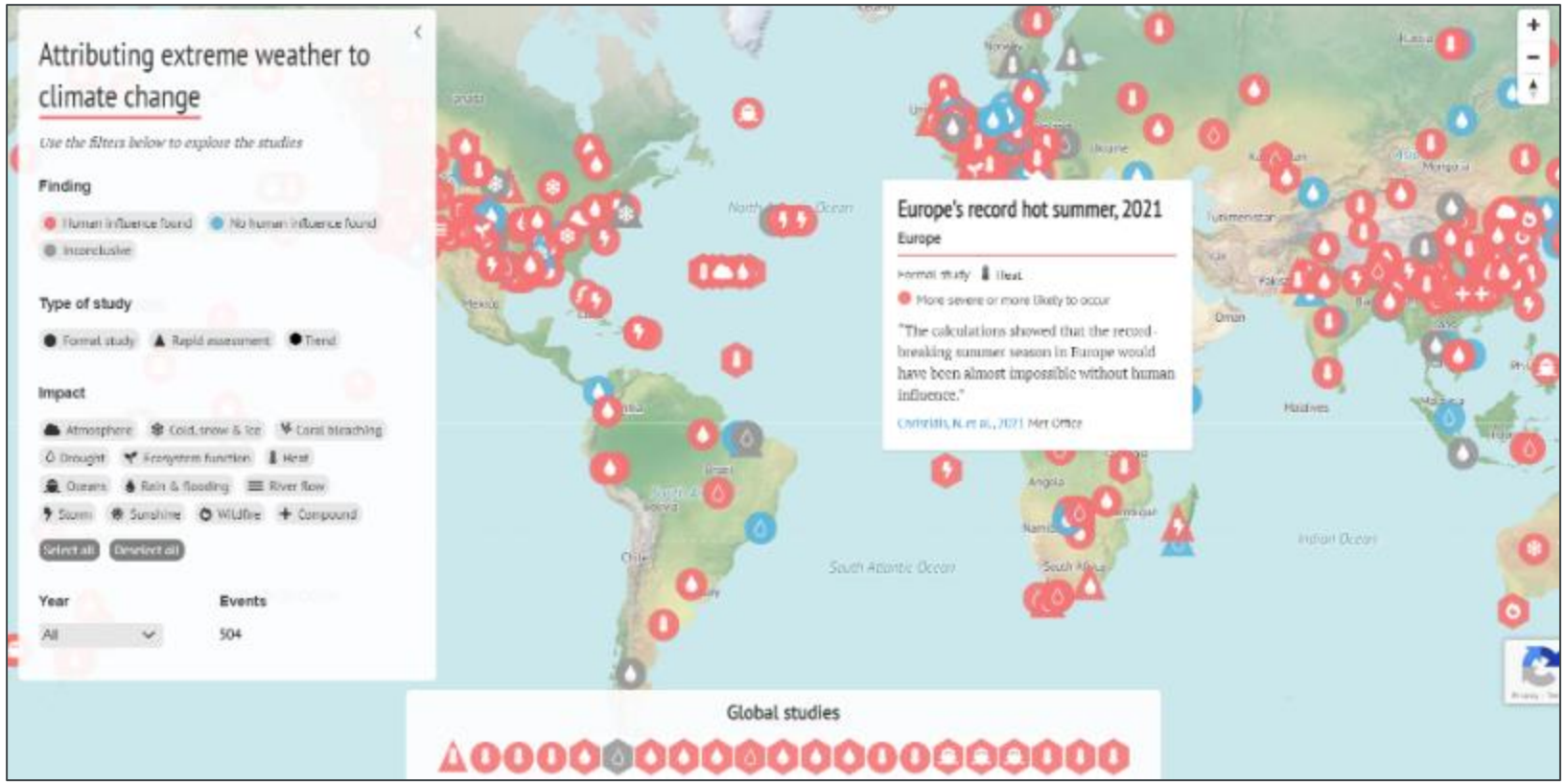


Institute and Faculty of Actuaries

Sources: *IPCC*

Life in the tail – more stings and more painful

Global attribution map of extreme weather events to climate change



Increase of record-breaking events across the globe, impacting billions of people.

Increasing frequency and magnitude as the planet warms further.

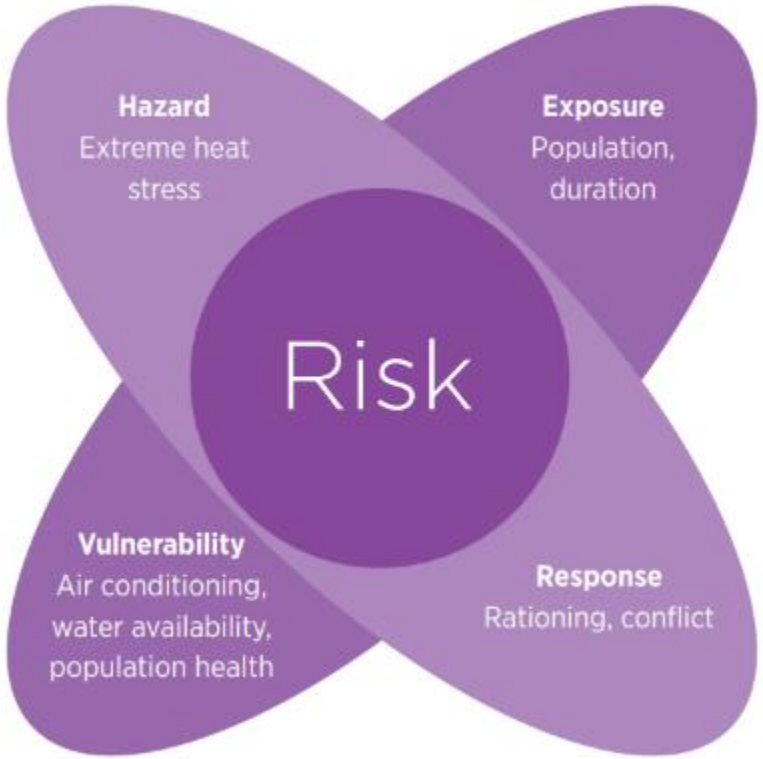
Economic impacts trending towards trillions

Institute and Faculty of Actuaries

Sources: *Source: Carbon Brief Mapped: How climate change affects extreme weather around the world (carbonbrief.org*

Systemic risk assessment

The hazard, exposure, vulnerability, response model for risk assessment



Emerging infectious diseases

Food insecurity

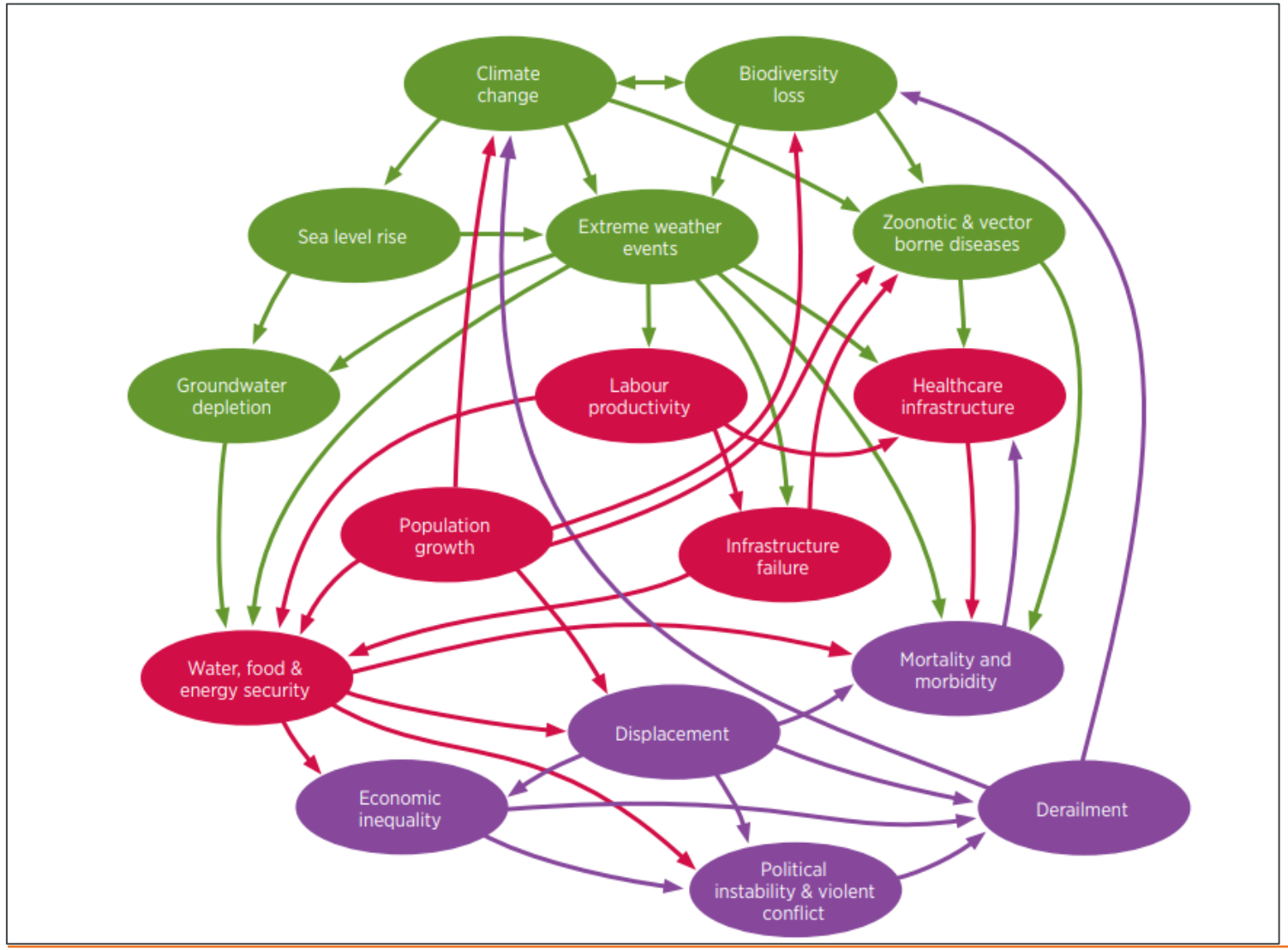
Water security

Extreme heat stress

Institute and Faculty of Actuaries

Sources: *Source: Carbon Brief Mapped: How climate change affects extreme weather around the world (carbonbrief.org*

Climate change as a driver for interconnected risks



Source: Lucy Saye

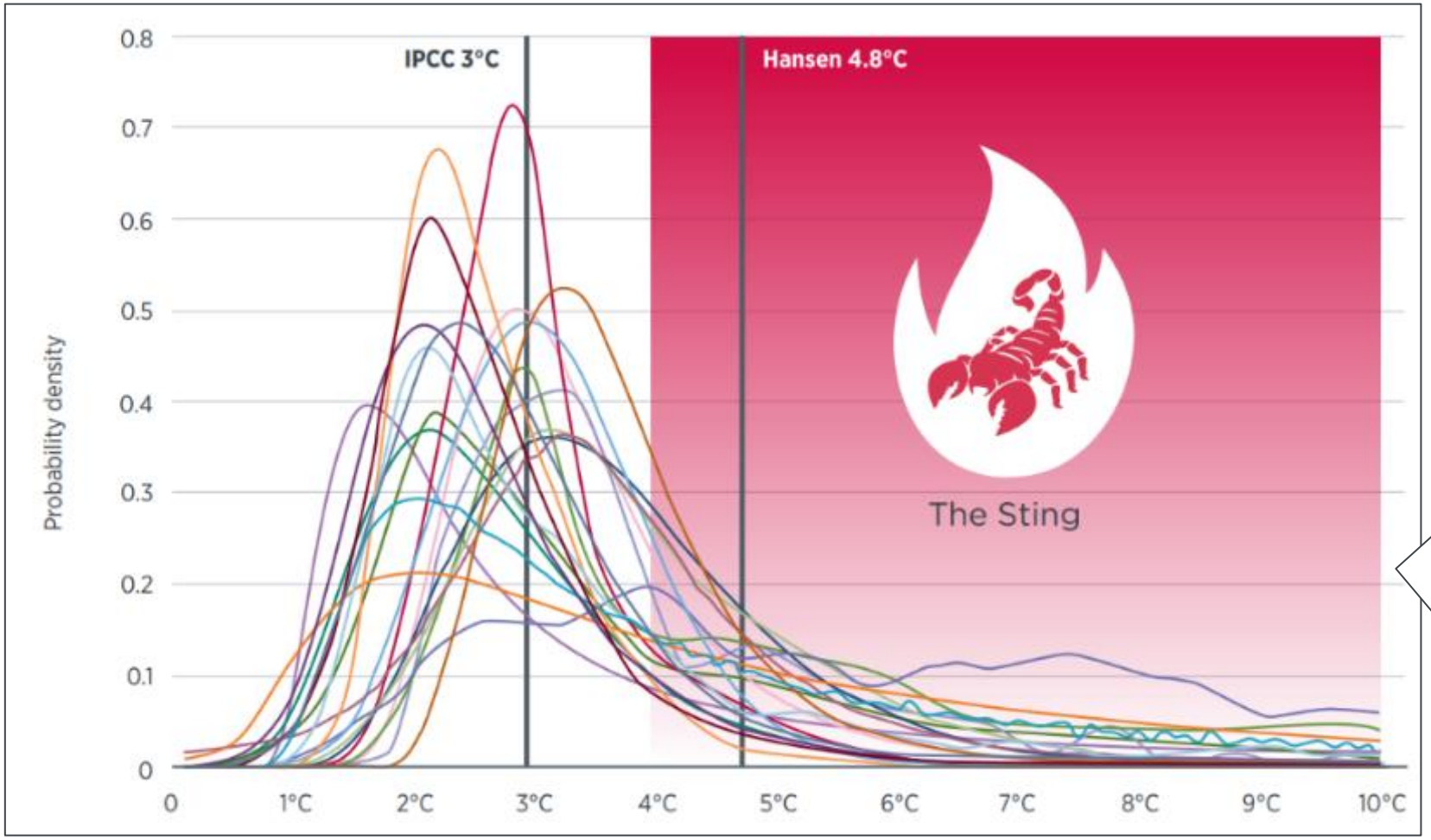
Complex, compounding, cascading – characteristics of interconnected risks.

Failure to consider interconnections leads to underestimation of risk and societal impacts.

Derailment risk – response to increasingly chaotic conditions could divert focus from environmental action.

Institute and Faculty of Actuaries

The sting in the tail of climate sensitivity



ECS has a long tail to higher temperatures. This is due to uncertainties in the magnitude of feedbacks, such as aerosol cooling, cloud formation and break-up. Because of this uncertainty, estimates vary substantially.

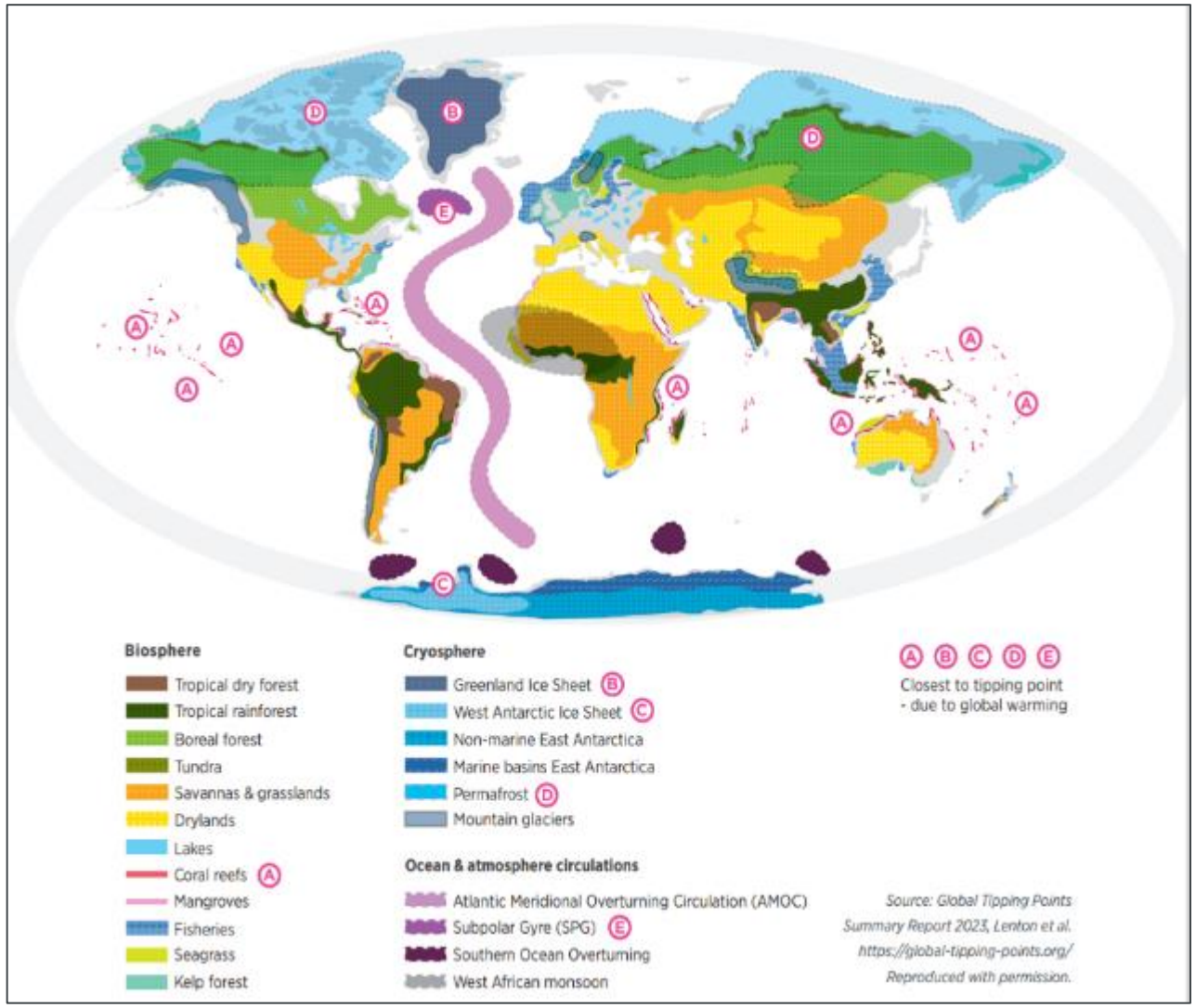
Under the latest IPCC estimates there is an 18% chance of ECS being greater than 4.5°C.

…a higher probability than the chance of failure in the game of Russian Roulette.

and Faculty of Actuaries

Source: Climate Scorpion – the sting is the tail

Overshoot of 1.5°C increases climate tipping point risk



It re-emphasizes how important it is to treat 1.5°C as a physical limit and not a political target, recognizing the risk from tipping points.

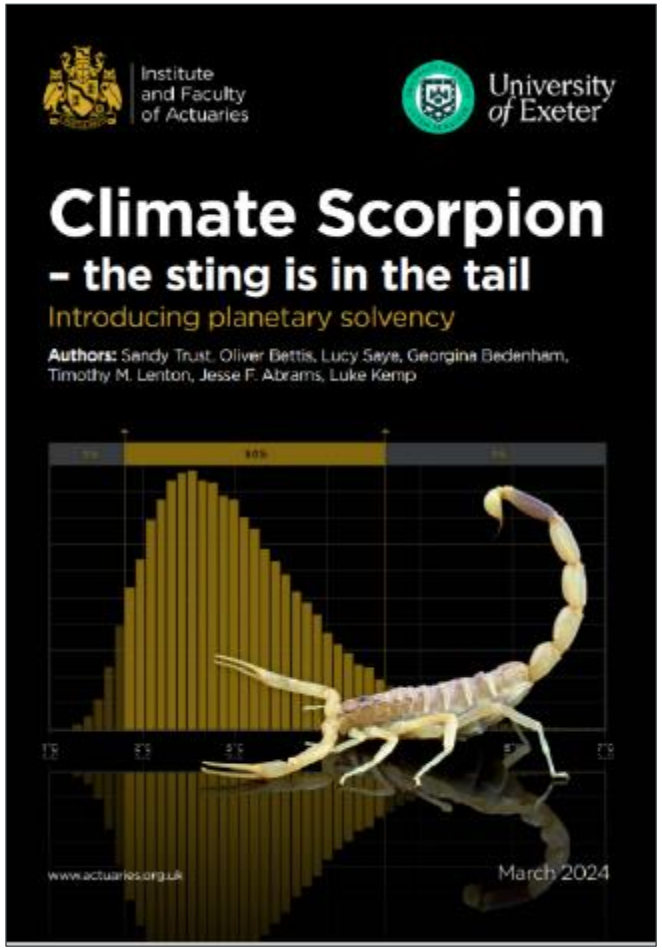
Four of these are showing scientific evidence of now being at risk already at 1.5°C, really putting humanity's future at risk.

Professor Johan Rockstrom

Institute and Faculty of Actuaries

Source: Global Tipping Points

Climate Scorpion – Recommendations



1. **Carry out a realistic risk assessment of climate change as a matter of urgency, and act on it.**

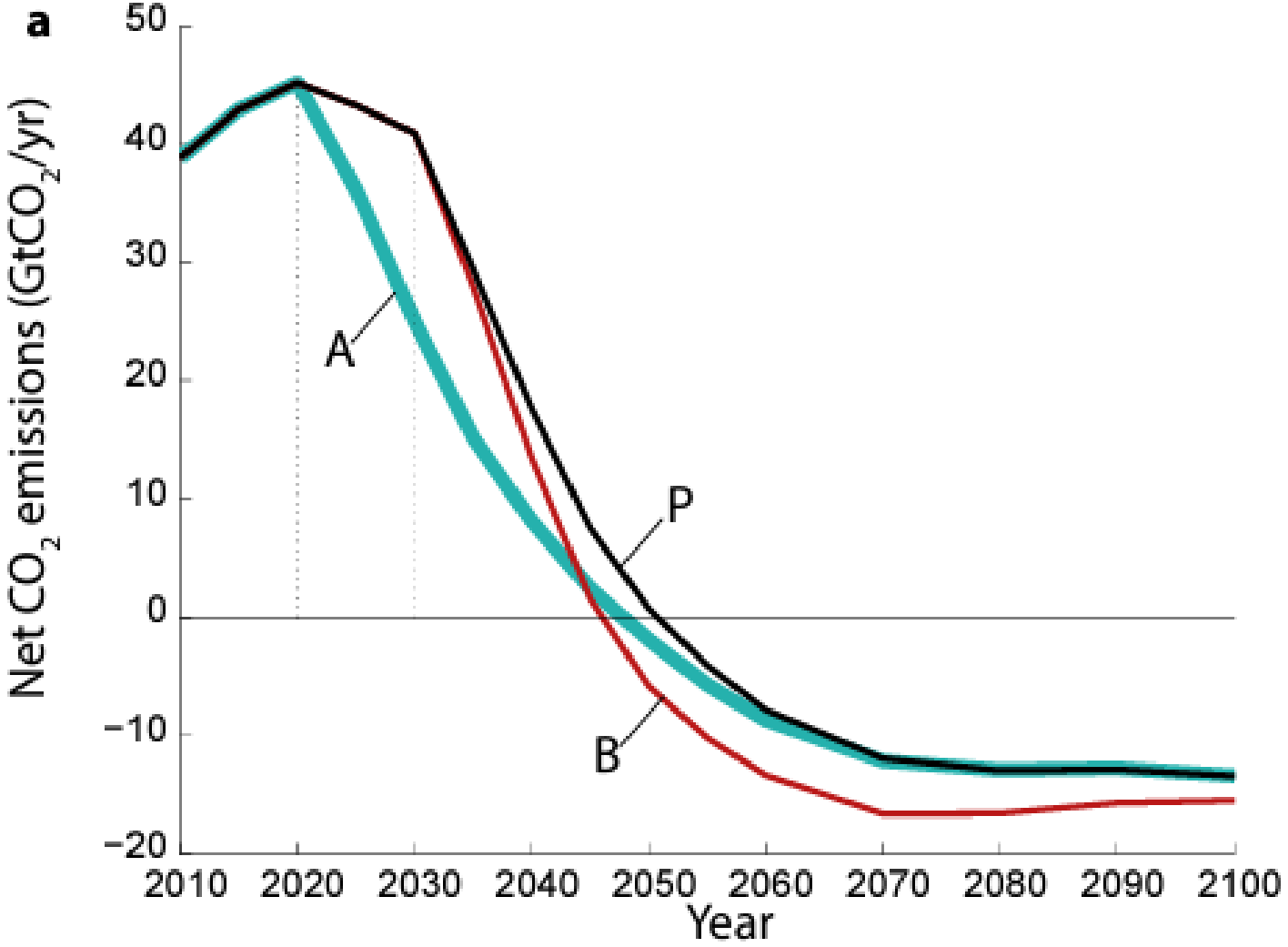
2. **Educate and take action to accelerate positive tipping points in the economic system.**

3. **Develop a Planetary Solvency framework to support long term policy decisions.**

4. **Financial services institutions should review net zero approaches and related assumptions.**

Institute and Faculty of Actuaries

A need to review net zero budgets and approaches



Possible implications for financial services firms:

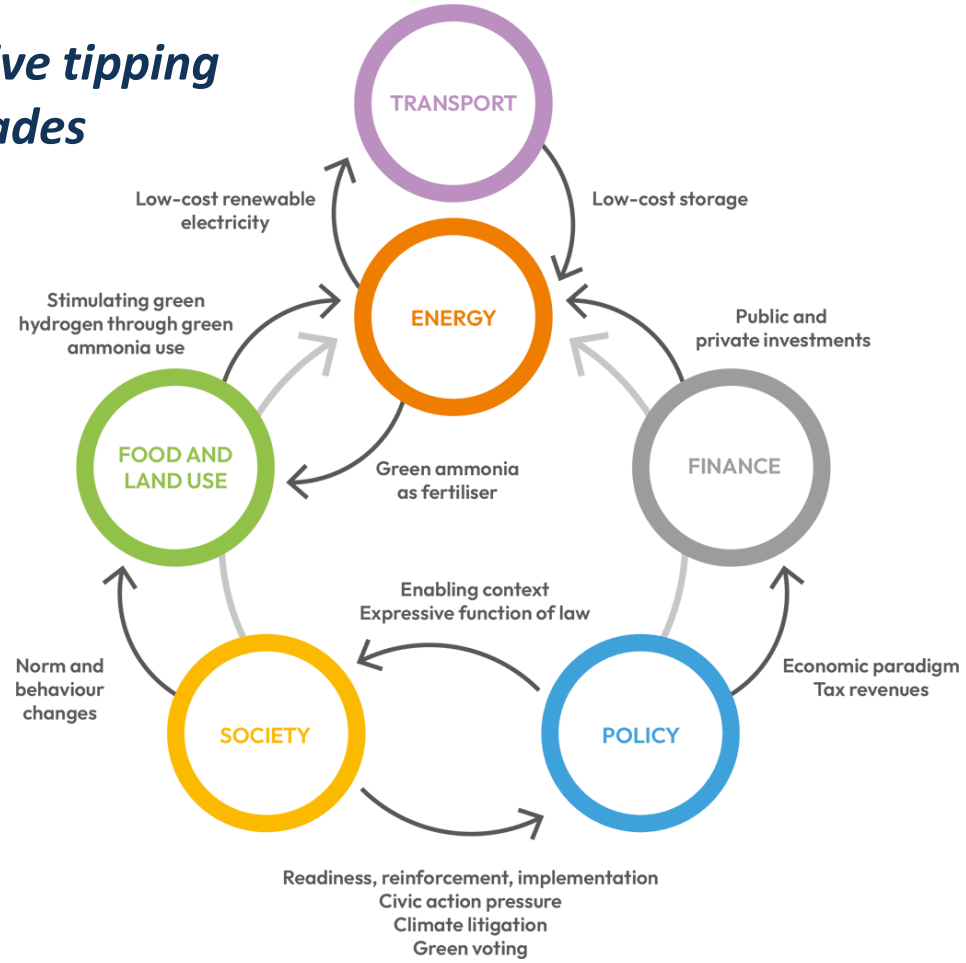
- A need to re-visit carbon budgets and related assumptions;
- Consider moving away from temperature commitments to focus on supporting real world decarbonization;
- Consider how to support policy action to accelerate positive tipping points?

Institute and Faculty of Actuaries

Source: 2018 IPCC Special Report on 1.5C Summary for Policymakers — Global Warming of 1.5 ºC (ipcc.ch)

Education and action on positive tipping points

Positive tipping cascades



Climate Stability

Tipping points

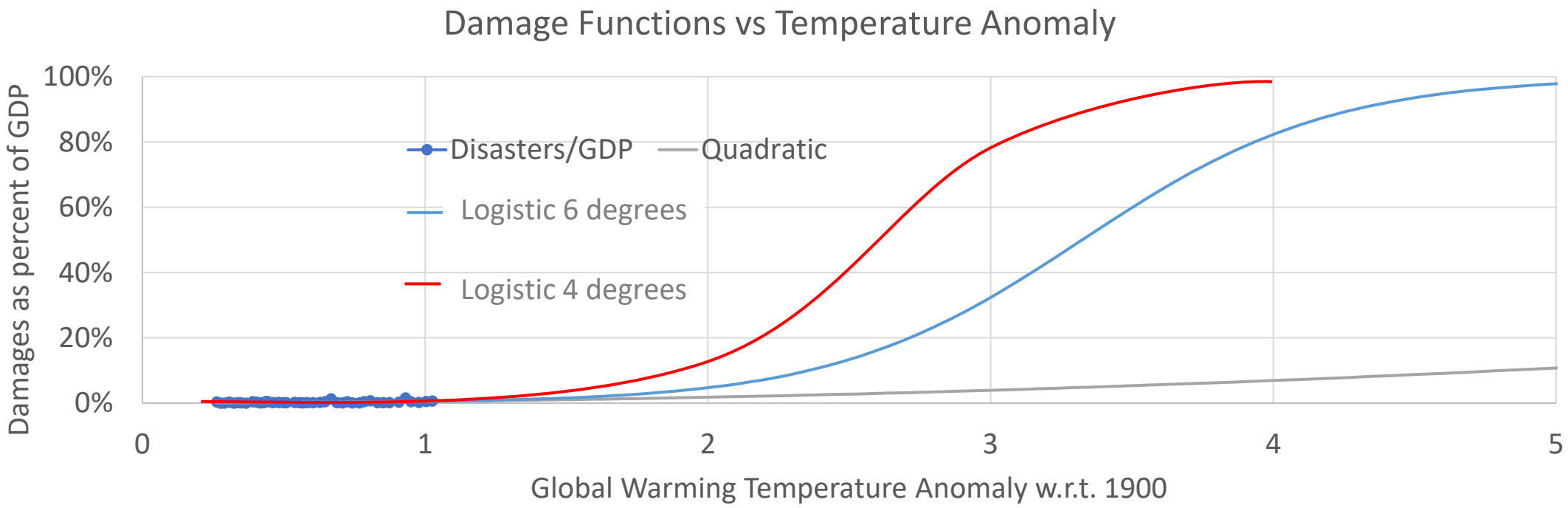
- Capital flows
- Cost of renewables
- Societal beliefs
- Political motivation
....

Now – Climate Emergency

Institute and Faculty of Actuaries

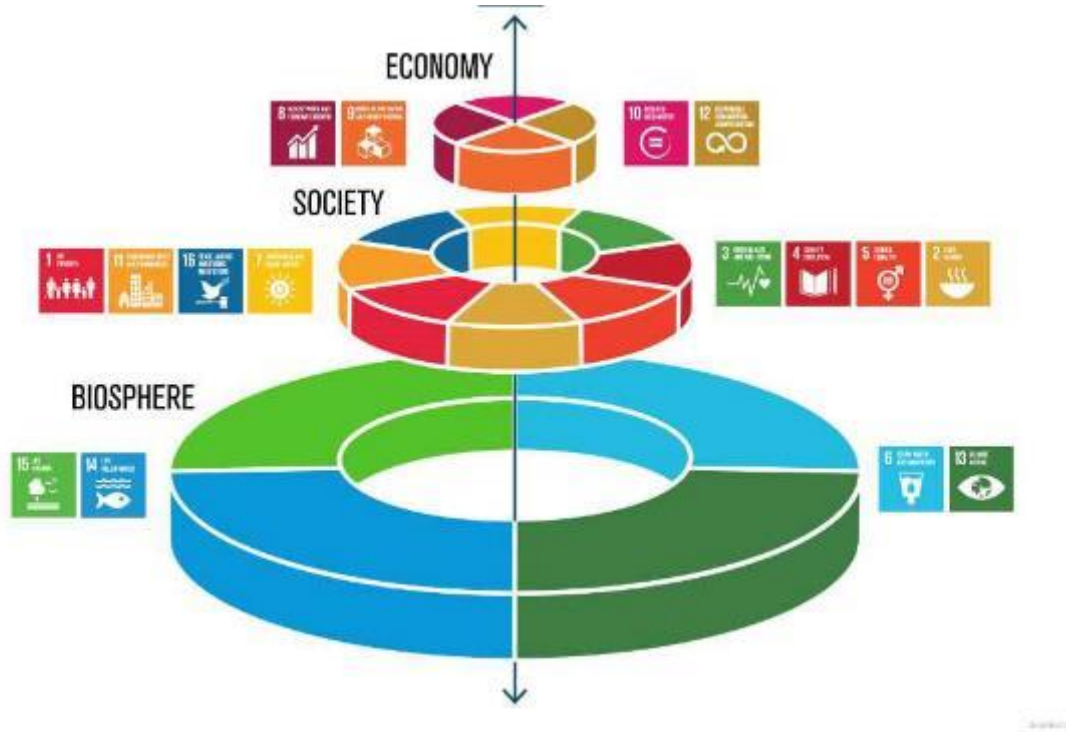
Source: Global Tipping Points

Something a little more realistic?



Institute and Faculty of Actuaries

The Earth System is the foundation for our civilisation

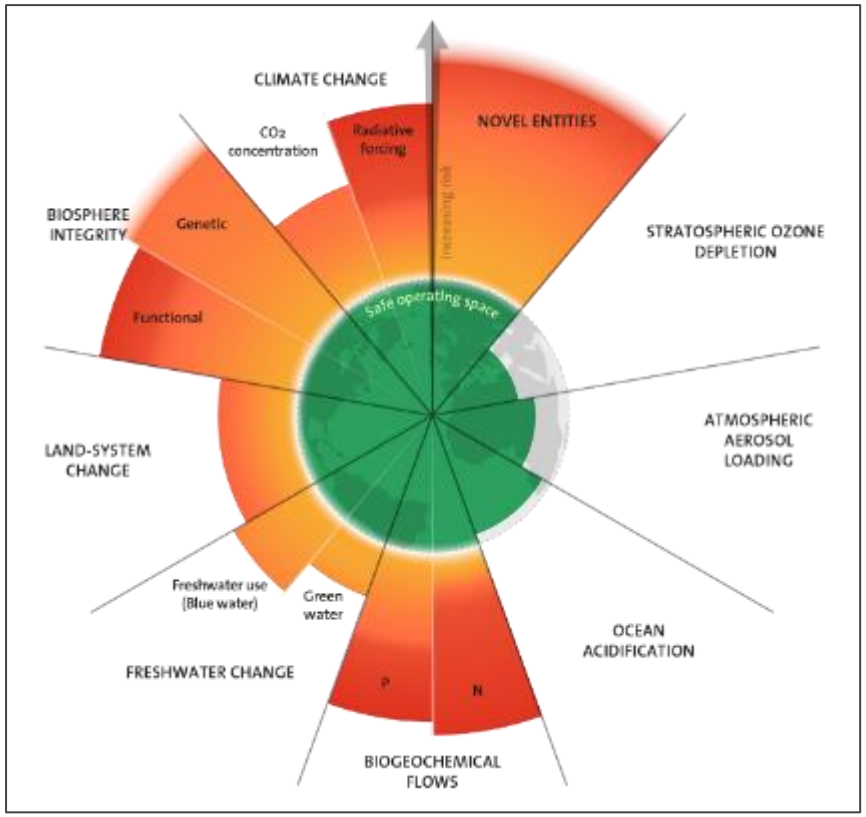


- Human society and economy rest on a stable biosphere
- The biosphere provides food, water, air, energy and raw materials to us
- Human activity is now threatening the stability of that foundation
- Risking our ability to maintain our global society and economy
- As a species we risk becoming insolvent on a planetary scale

Institute and Faculty of Actuaries

Planetary solvency protects citizens from the ruin of their environment – and hence civilisation

Planetary boundaries – solvency limits

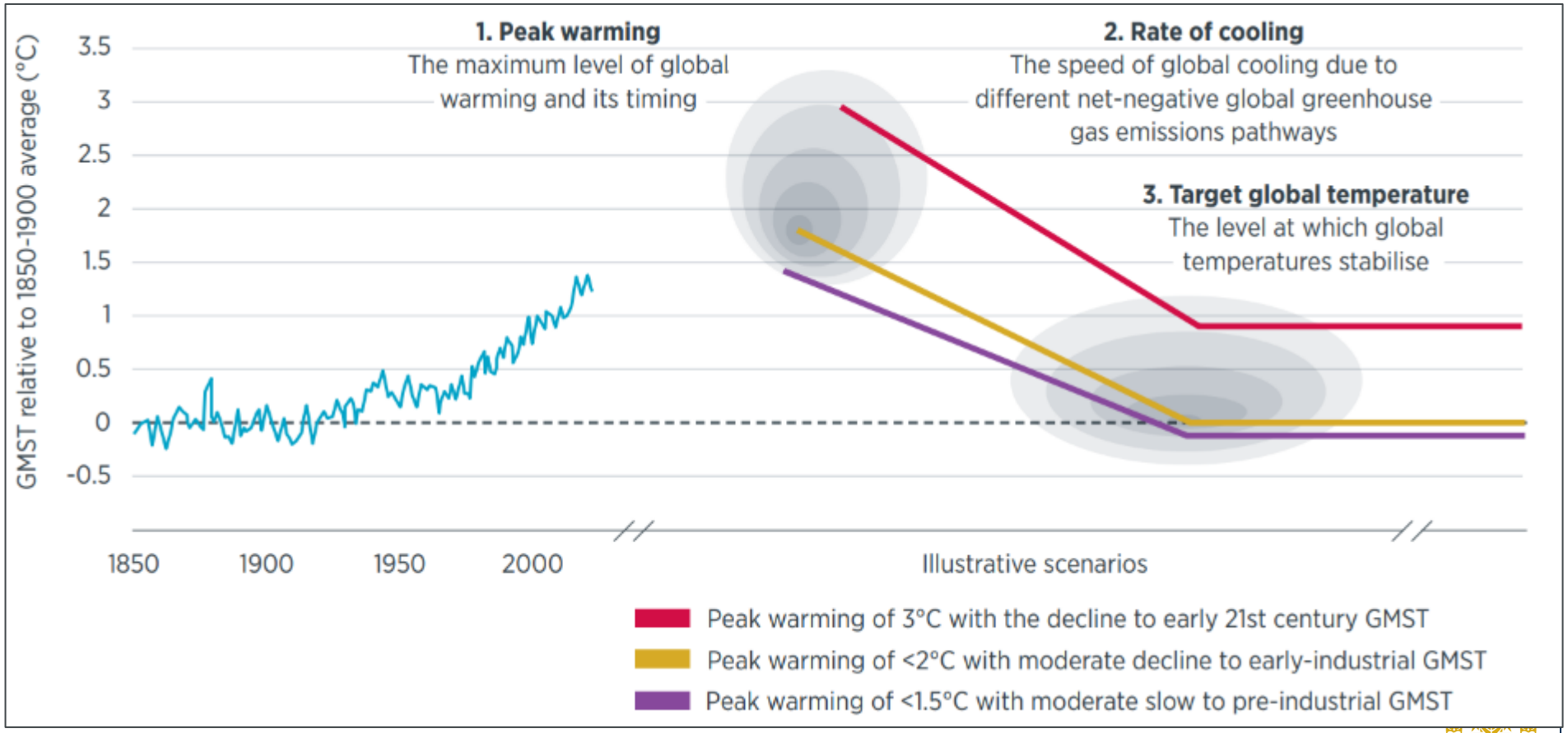


Applying an actuarial approach

- Develop risk likelihood and impacts
- What biosphere risk drivers would cause societal collapse/extinction/GDP collapse?
- How close are we to that on current trajectories?
- What action do we need to take to avoid these outcomes?
- Nature, climate, society

Institute and Faculty of Actuaries

Planetary solvency – long term climate objectives



Institute and Faculty of Actuaries

Source: Preparing for a post-net-zero world | A D King et al (nature.com)

Questions

Comments

Expressions of individual views by members of the Institute and Faculty of Actuaries and its staff are encouraged.

The views expressed in this presentation are those of the presenters.

Institute and Faculty of Actuaries