



POTSDAM INSTITUTE FOR
CLIMATE IMPACT RESEARCH





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International Conference on Science and Technology for Sustainability: Achieving Net Zero Emissions: The Roles of Academia

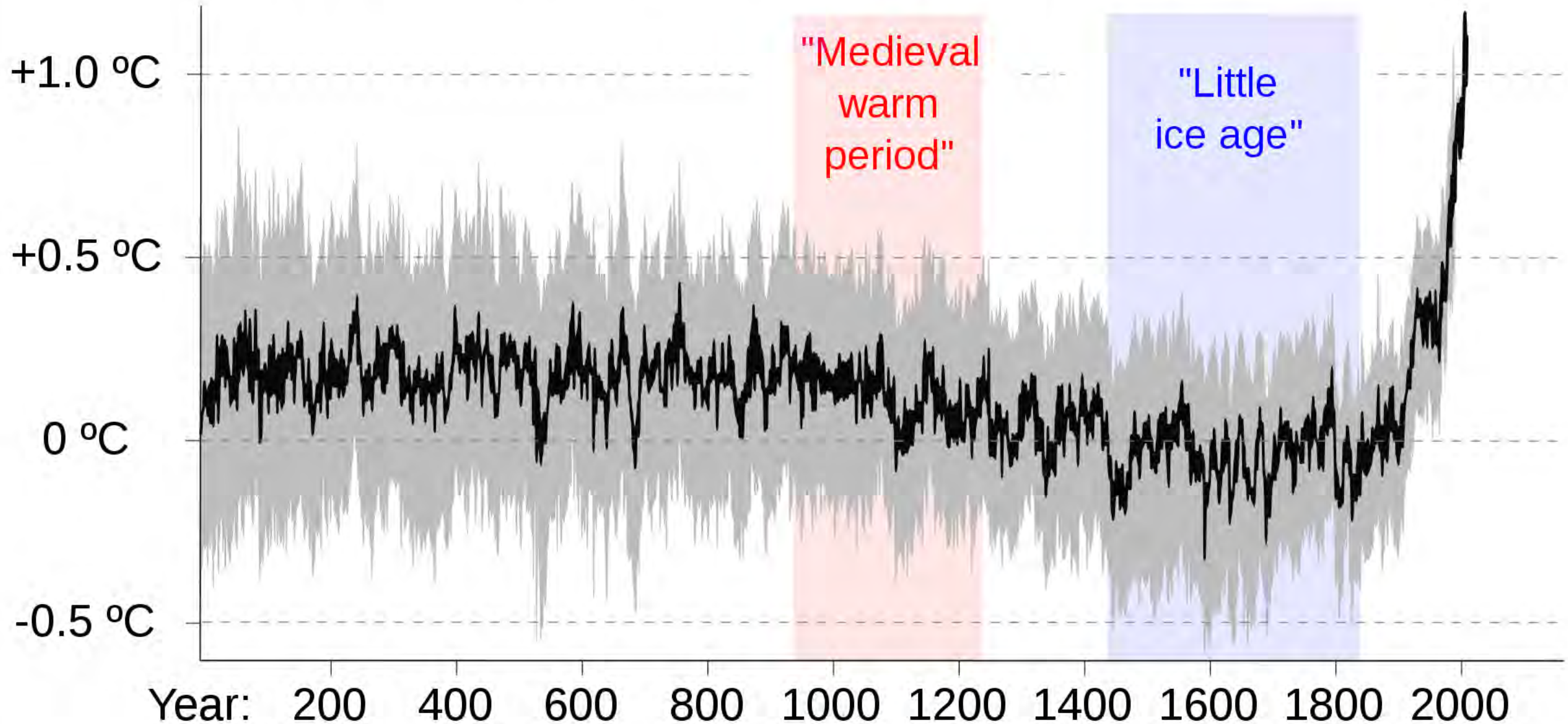
January 31, 2022

Prof. Dr. Johan Rockström

Director, Potsdam Institute for Climate Impact Research

Professor in Earth System Science, University of Potsdam

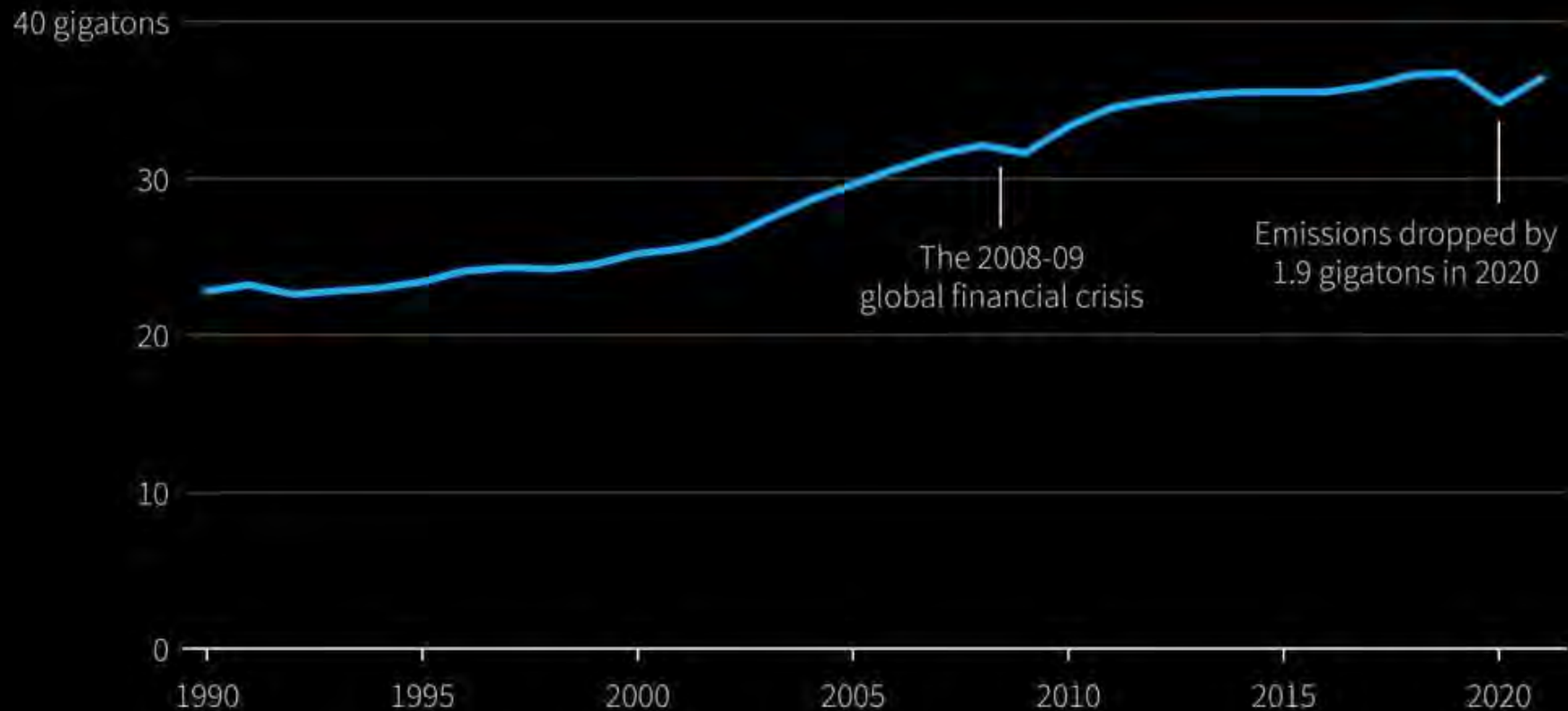
Global Average Temperature Change



Carbon emissions back to pre-pandemic levels

The world is projected to emit 36.4 gigatons of carbon dioxide in 2021, close to the 2019 levels, according to a report released by the Global Carbon Project research group. Emissions decreased by more than 5% in 2020 when the COVID-19 pandemic disrupted the world economy.

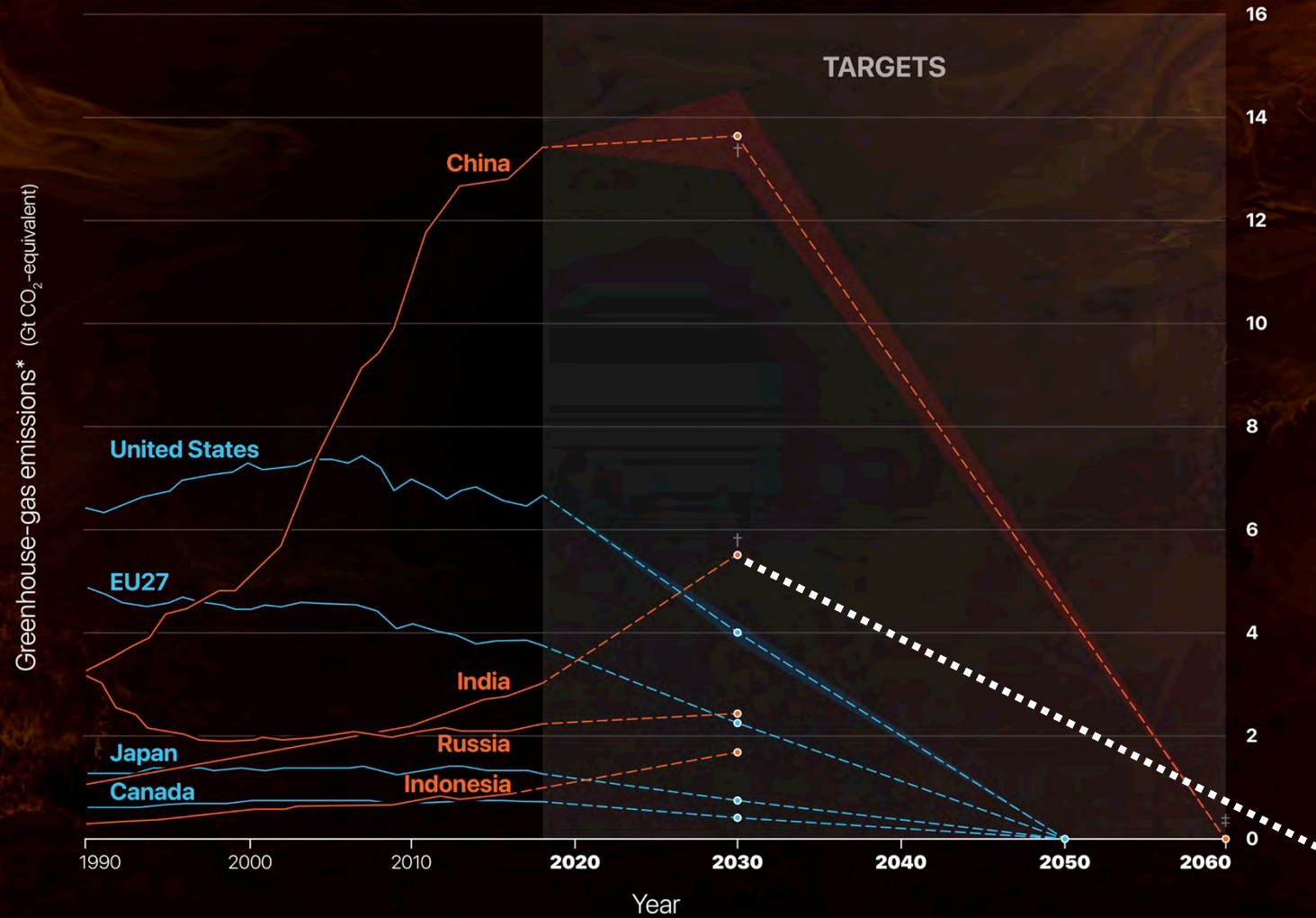
Annual carbon dioxide emissions from fossil fuel combustion and industrial processes



How climate targets compare against a common baseline

Four largest emitters in **developed economies** and **emerging markets**

Source: The Economist, August 7th 2021



* Excluding forestry and other land use, except net-zero targets which include emissions removals from these sources

† Multiple targets

* Unclear whether this targets CO₂ or all greenhouse gases

Net-Zero Pathway Countries (selection)

Country	Net-Zero-Target-Date	Target Emission Reduction by 2030	Status
Germany	2045	65%	In Law
Sweden	2045	63 %	In Law
Japan	2050	46%	In Law
EU	2050	55%	In Law
United Kingdom	2050	68% and 78% by 2035	In Law
South Korea	2050	40%	In Law
New Zealand	250	50 %	In Law
United States of America	2050	50-52%	In Policy Document
China	2060	65%	In Policy Document
India	2070	1 billion tons (33-38%)	Declaration/Pledge
Russian Federation	2060	30%	Declaration/Pledge

Risks compared to Pathways

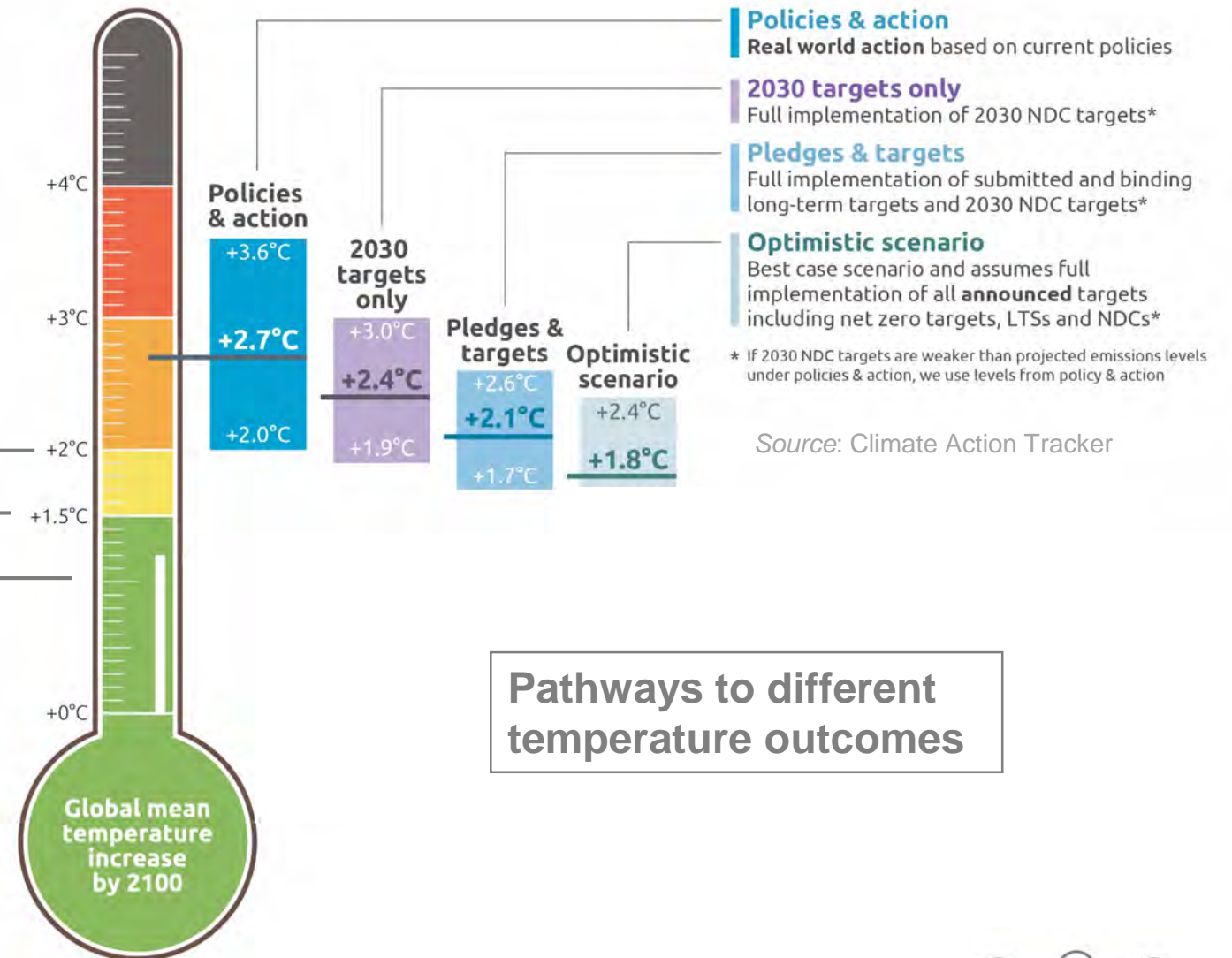
Risk of crossing tipping points

>2°C Very High Risk

<2°C High Risk

<1.5°C Moderate Risk

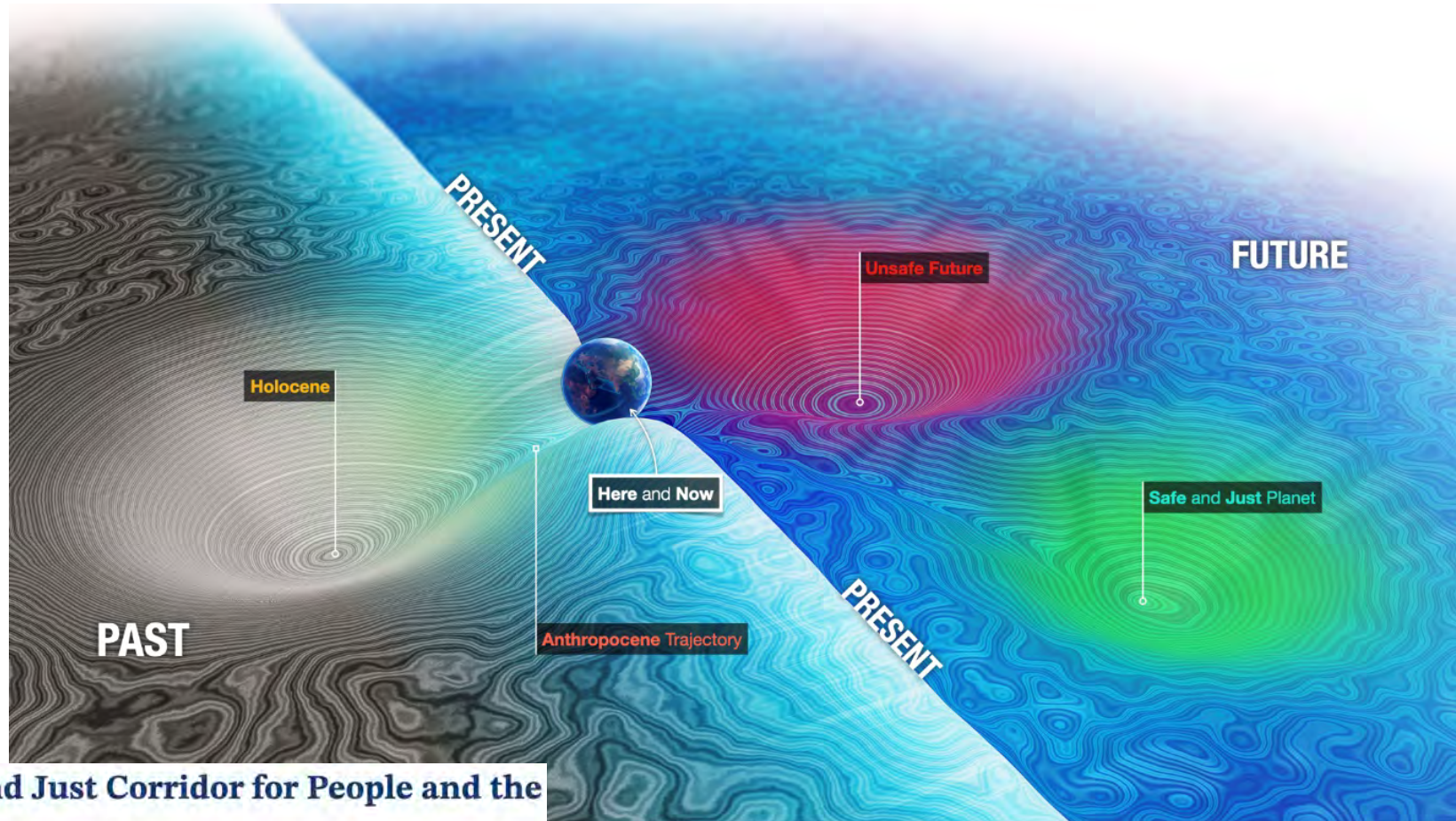
<1°C Low Risk



Pathways to different temperature outcomes

Source: risk evaluation based on David McKay et al., under Review (2022); Earth Commission

Navigating the Anthropocene: Transformations to a Safe and Just Operating Space

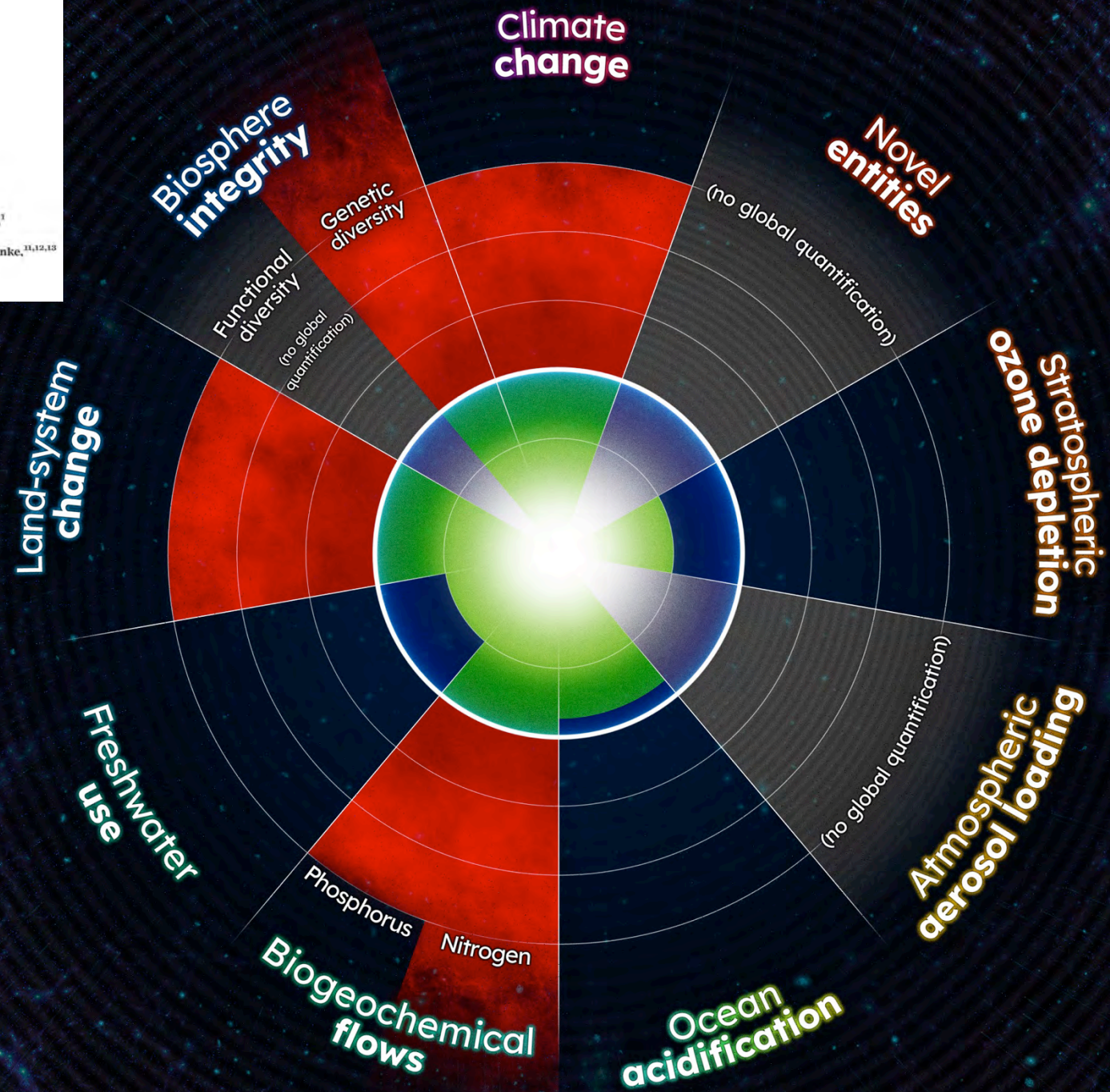


Identifying a Safe and Just Corridor for People and the Planet

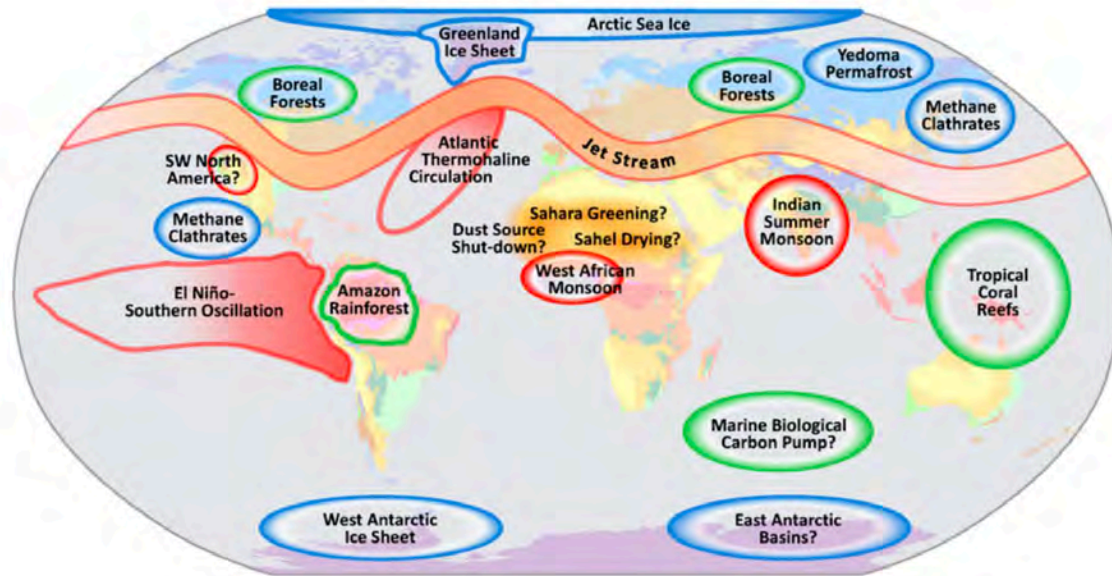
Johan Rockström^{1,2}, Joyeeta Gupta^{3,4}, Timothy M. Lenton⁵, Dahe Qin^{6,7,8}, Steven J. Lade^{9,10,11}, Jesse F. Abrams⁵, Lisa Jacobson⁹, Juan C. Rocha^{9,10}, Caroline Zimm¹¹, Xuemei Bai¹², Govindasamy Bala¹³, Stefan Brinzeu¹⁴, Wendy Broadgate⁹, Stuart E. Bunn¹⁵, Fabrice DeClerck^{16,17}, Kristie L. Ebi¹⁸, Peng Gong^{19,20,21}, Chris Gordon²², Norichika Kanie²³, Diana M. Liverman²⁴, Nebojsa Nakicenovic¹¹, David Obura²⁵, Veerabhadran Ramanathan²⁶, Peter H. Verburg^{27,28}, Detlef P. van Vuuren^{29,30}, and Ricarda Winkelmann^{1,31}

Planetary boundaries: Guiding human development on a changing planet

Will Steffen,^{1,2*} Katherine Richardson,³ Johan Rockström,¹ Sarah E. Cornell,¹ Ingo Fetzer,¹ Elena M. Bennett,⁴ Reinette Biggs,^{1,5} Stephen R. Carpenter,⁶ Wim de Vries,^{7,8} Cynthia A. de Wit,⁹ Carl Folke,^{1,10} Dieter Gerten,¹¹ Jens Heinke,^{11,12,13} Georgina M. Mace,¹⁴ Linn M. Persson,¹⁵ Veerabhadran Ramanathan,^{16,17} Belinda Reyers,^{1,18} Sverker Sörlin¹⁹



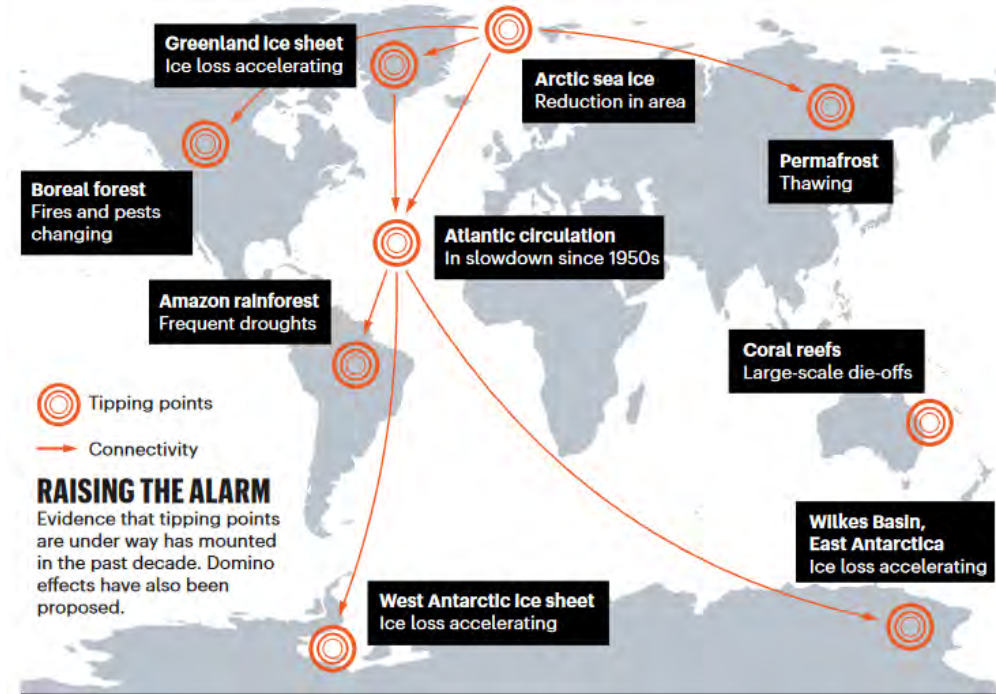
Tipping Elements in the Earth System – the Global Commons in the Anthropocene



- Cryosphere Entities
- Circulation Patterns
- Biosphere Components

Köppen Climate Classification

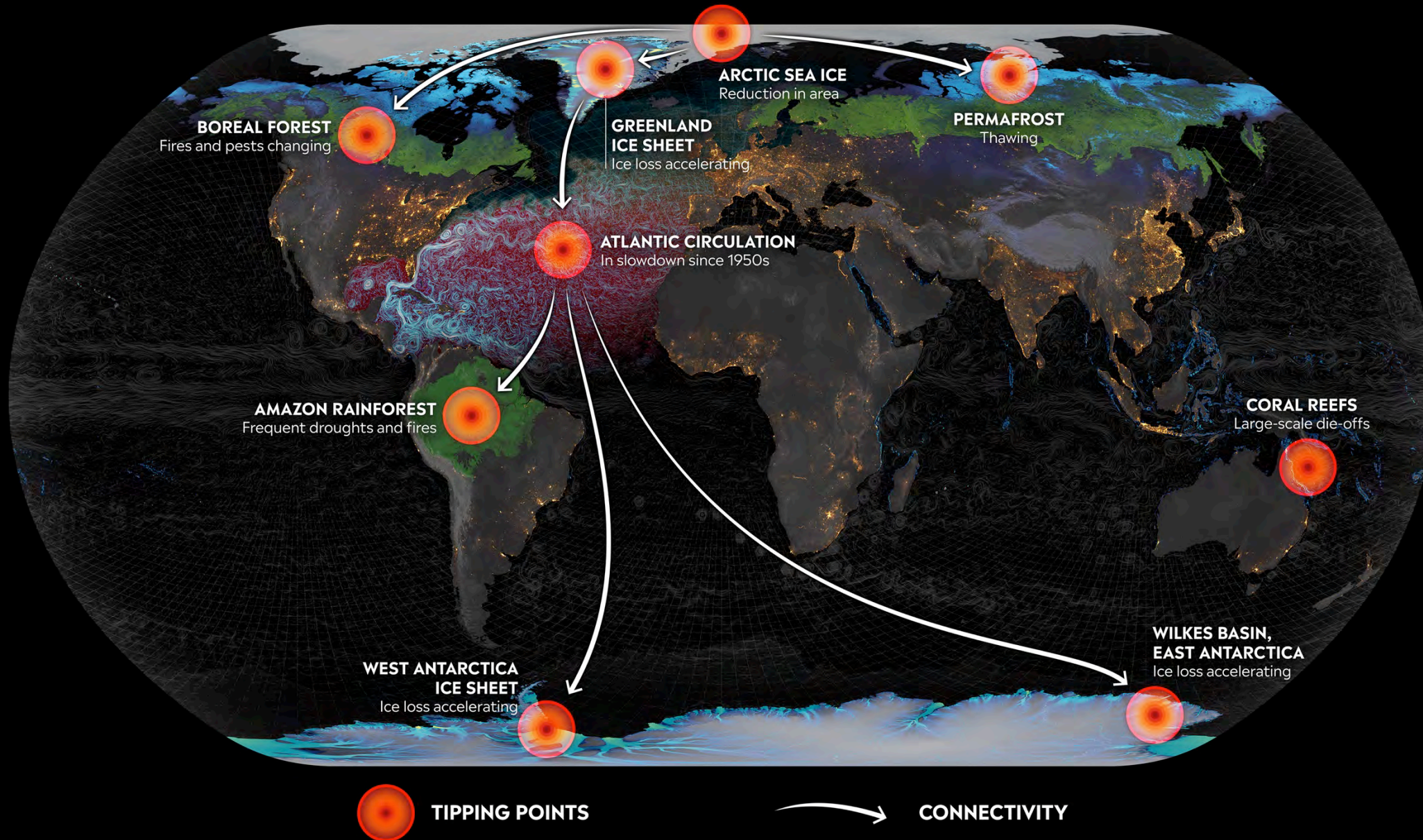
Ar Am Aw As BS BW Cr Cs Cw Do Dc Eo Ec FT FI



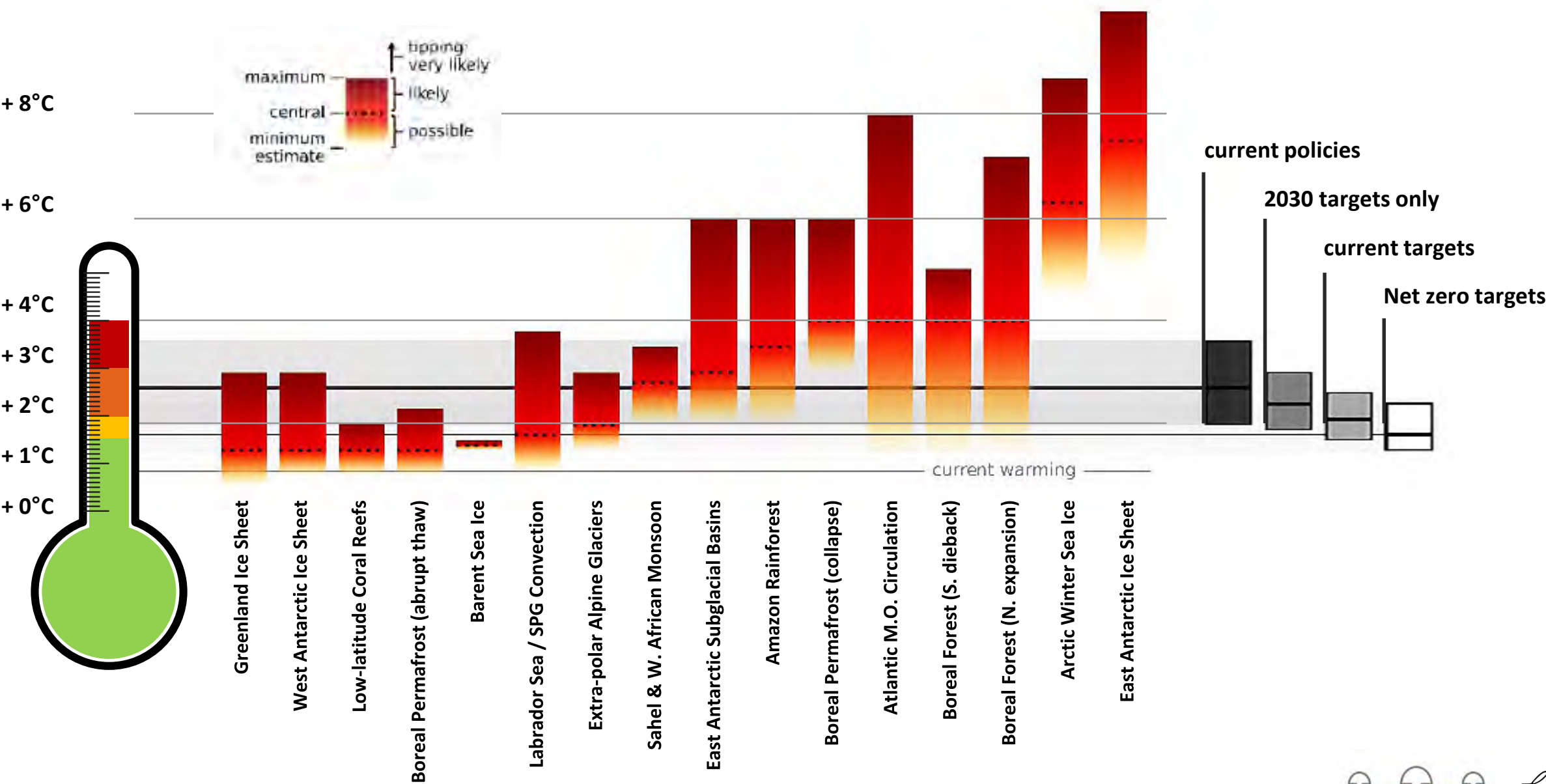
RAISING THE ALARM

Evidence that tipping points are under way has mounted in the past decade. Domino effects have also been proposed.

Tipping Points of the Earth System

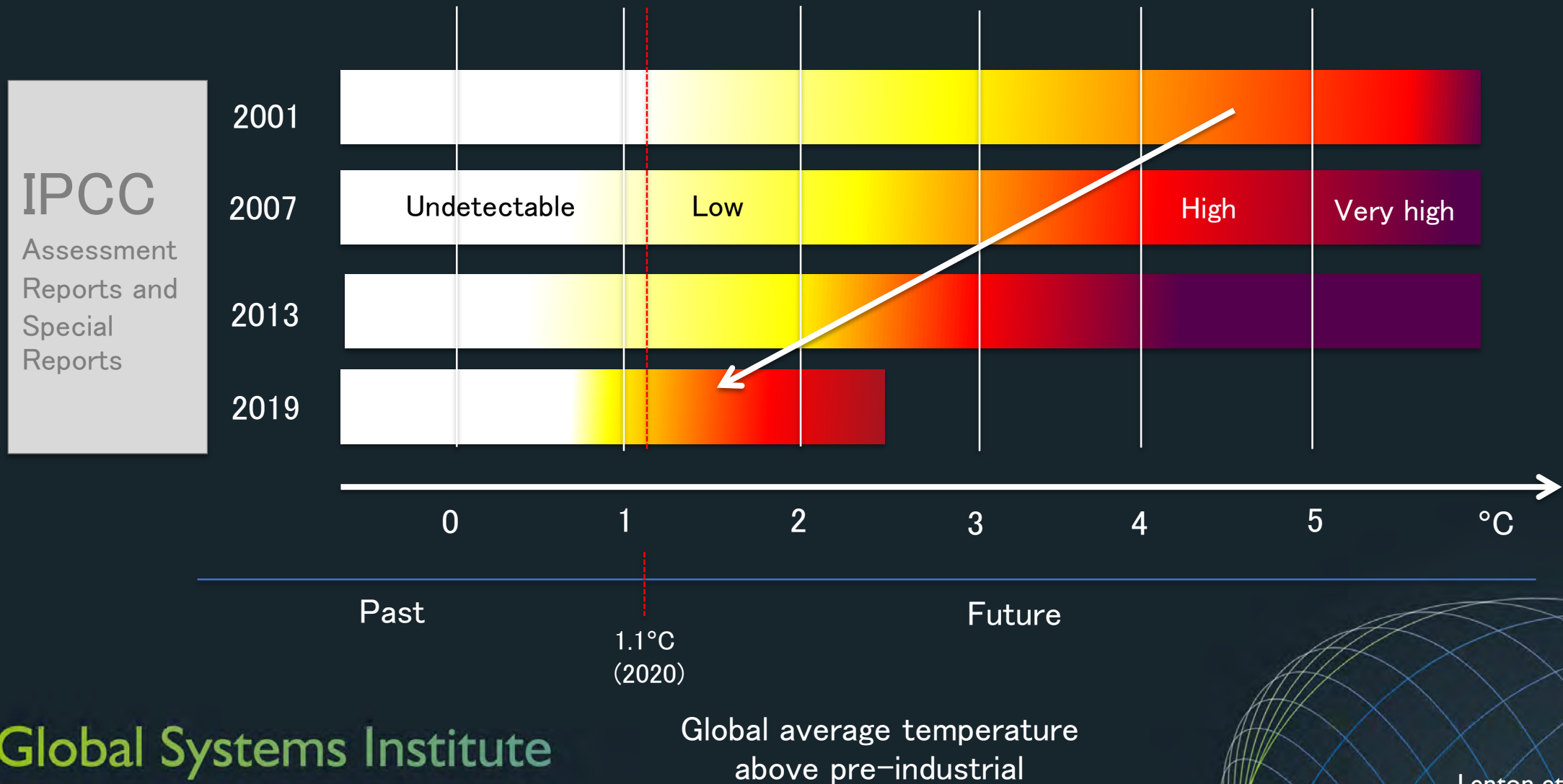


Likelihood of Crossing Multiple Tipping Points

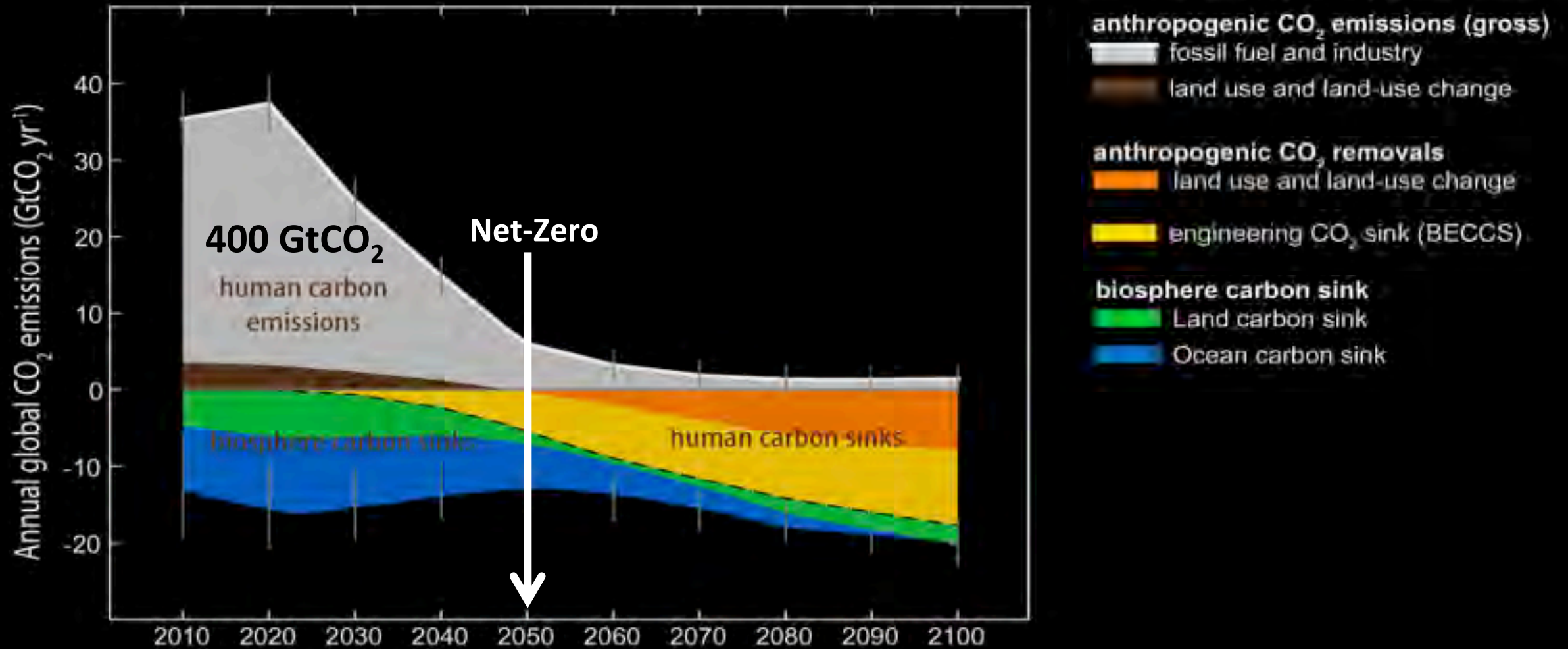


Source: adapted from David McKay et al., under Review (2022); Earth Commission

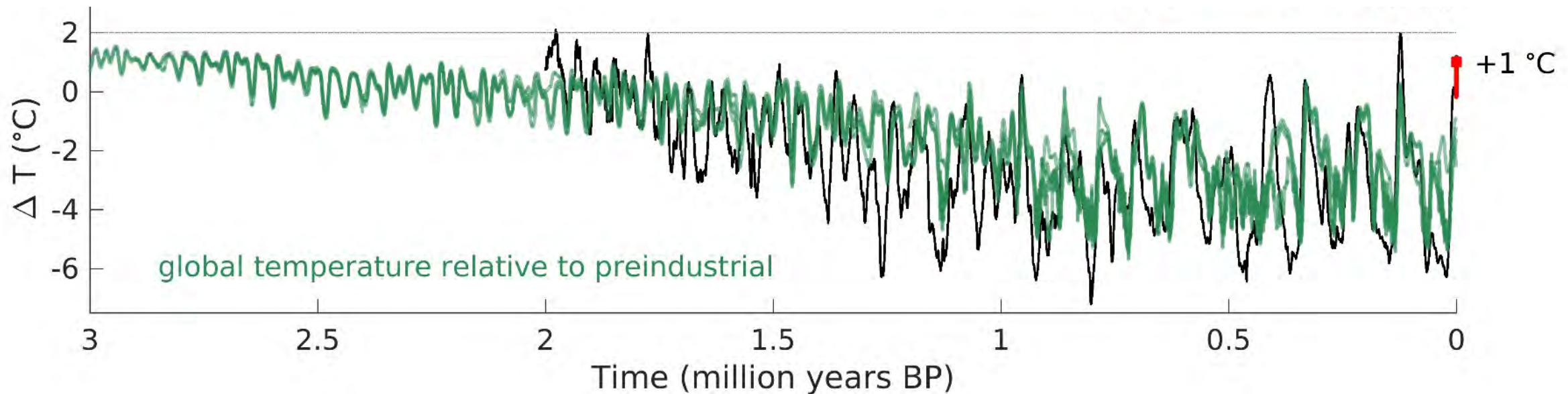
Changing risk assessment of tipping points



A Roadmap for Rapid Decarbonization



We have never exceeded 2 C in the last Three Million Years



Results of model simulations: Observations shown in black, model results in colour.

Global Commons Alliance, advancing SBTs for all Planetary Boundaries



SCIENCE BASED TARGETS NETWORK
GLOBAL COMMONS ALLIANCE

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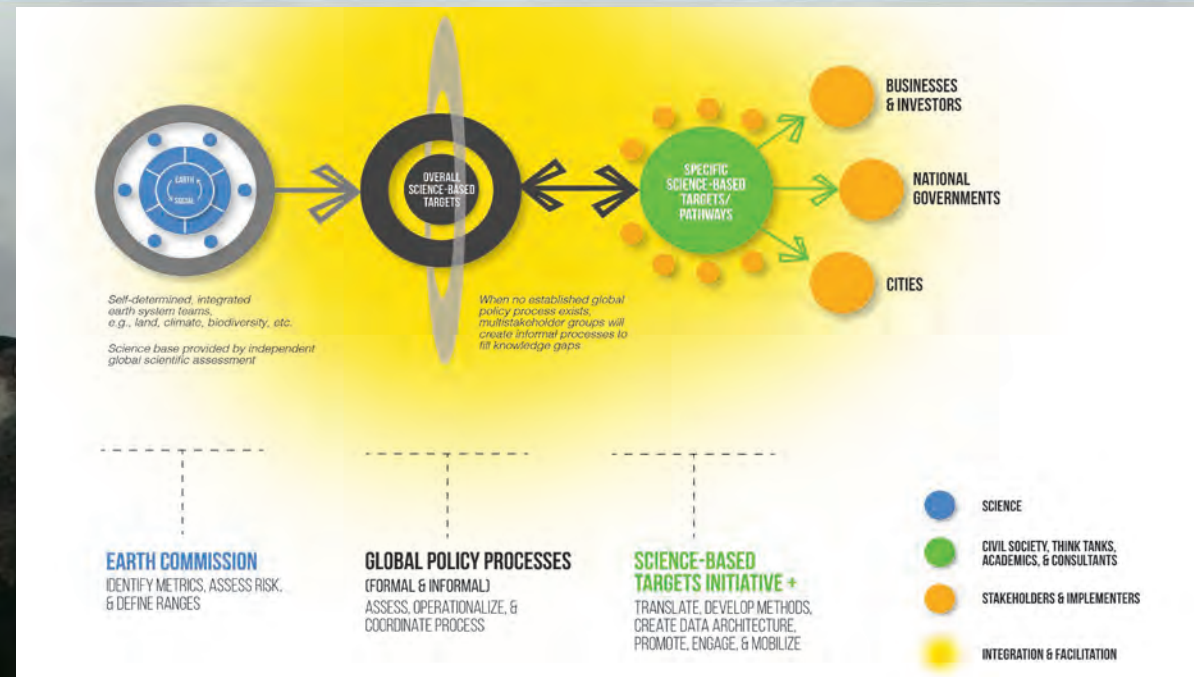
[How It Works](#) ▾

[Take Action Now](#) ▾

[Resources](#)

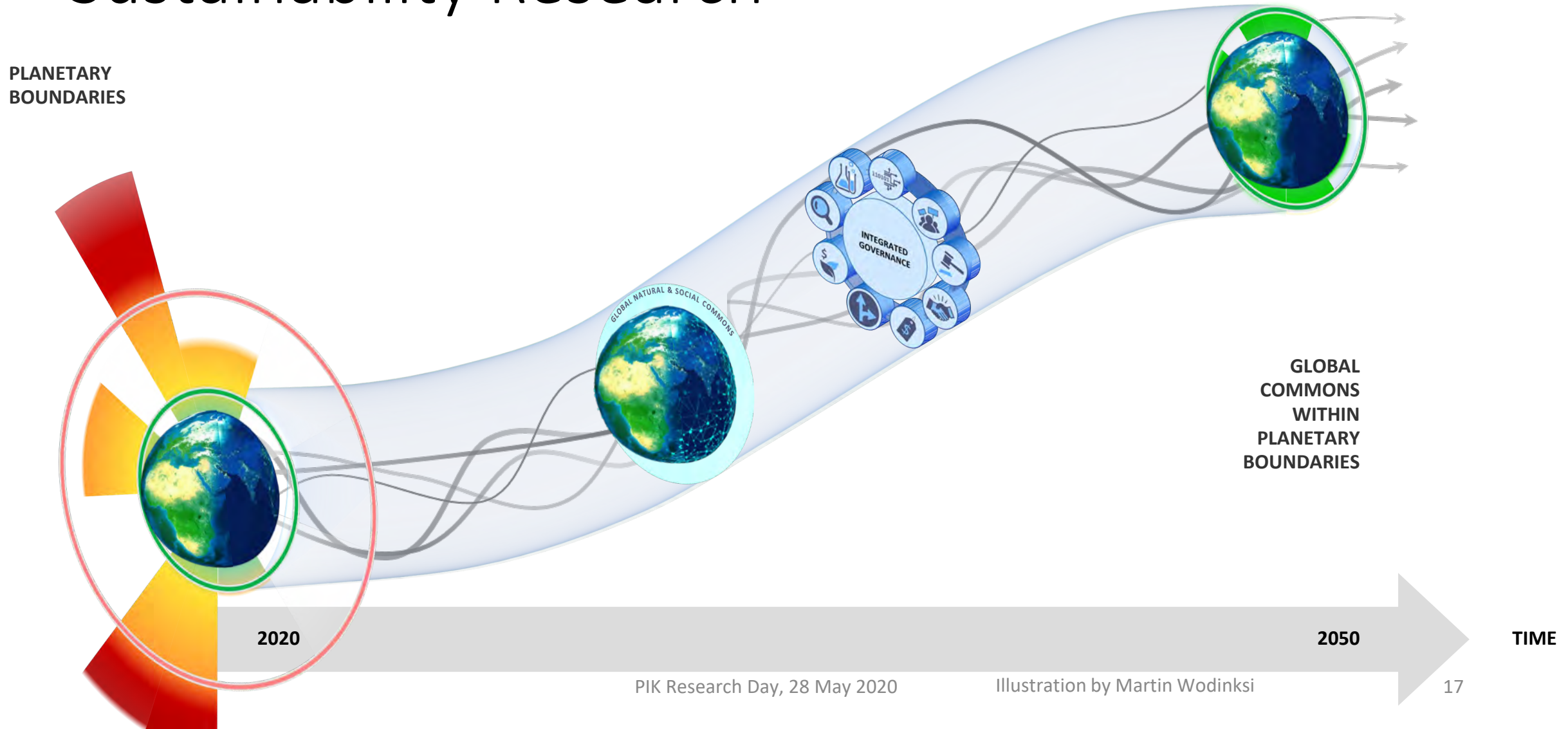
[News and Events](#) ▾

[Members-Only Corporate Engagement](#)

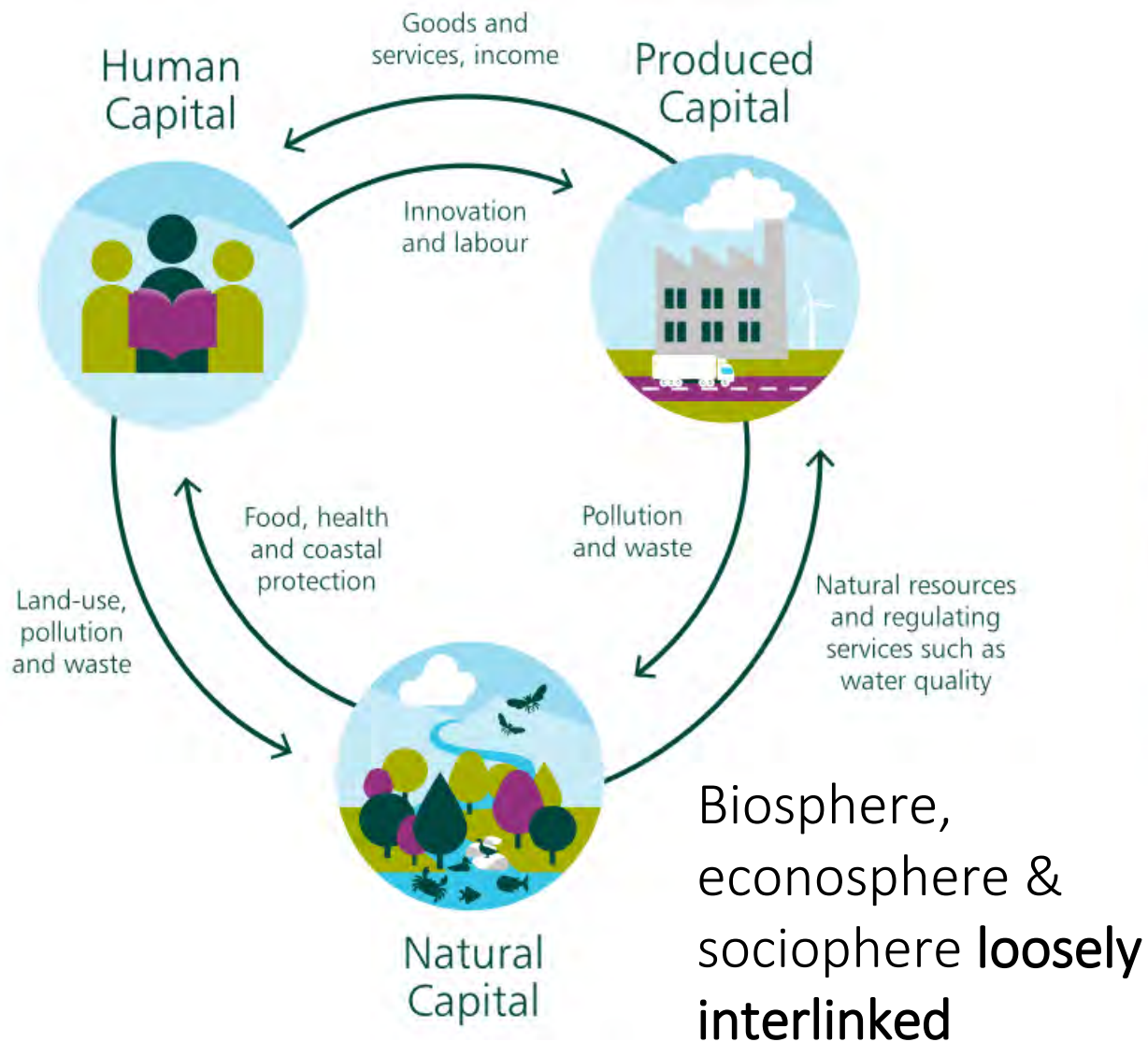


This work will improve upon *the Planetary Boundaries*, by mapping out *the* interconnections between different systems or boundaries, and adding a focus on equity...

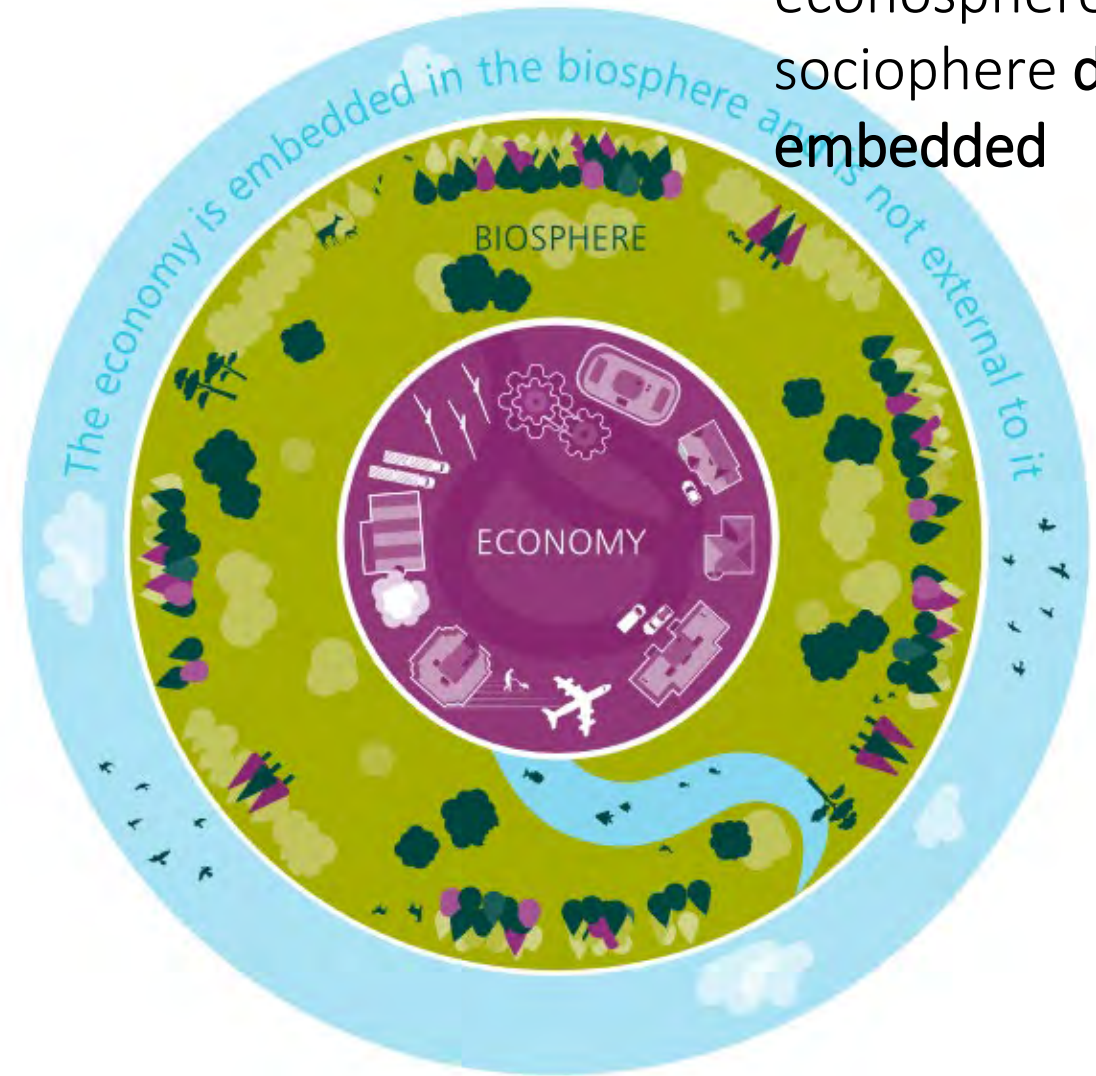
An Integrated Framework for Global Sustainability Research



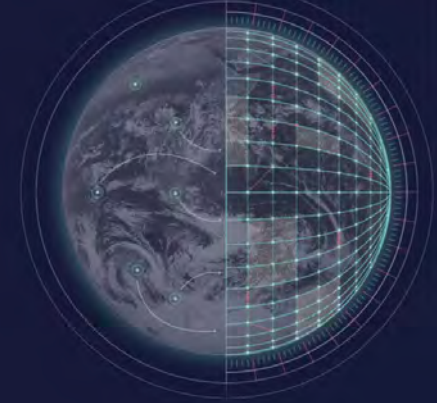
Weak and Strong Sustainability



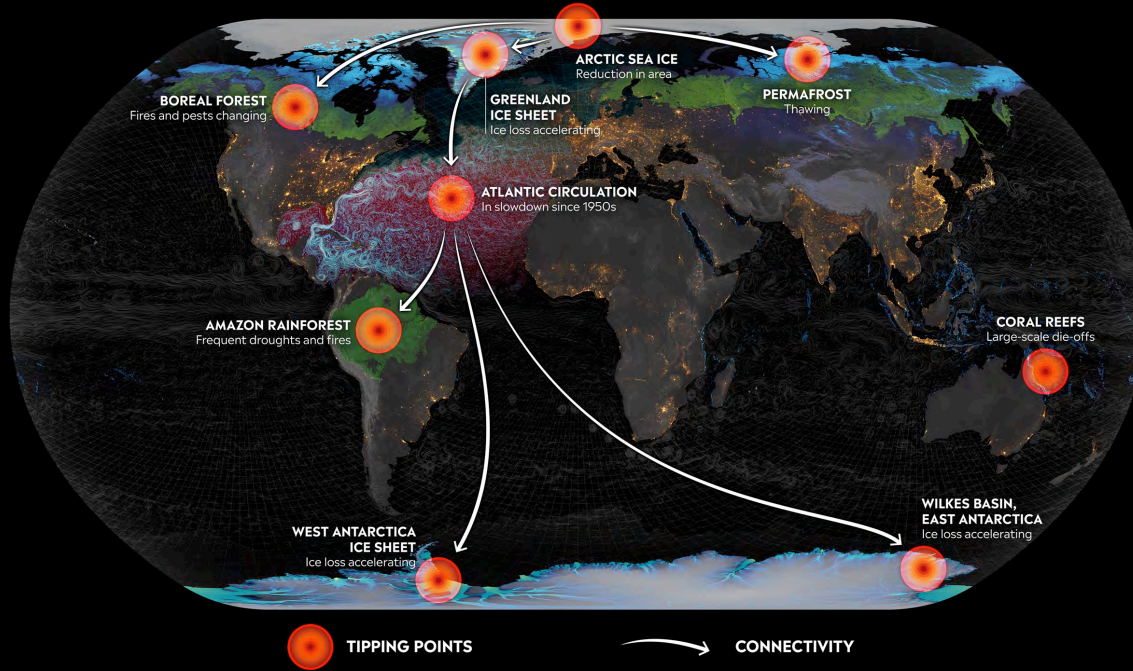
Biosphere, ecosphere & sociosphere **deeply embedded**



Earth Observation, Big Data, AI for Predicting Tipping Points and Earth Digital Twin research



Tipping Points of the Earth System



Key scientific challenges

1. Earth system tipping points.

TIPMIP on integrating Earth system interactions, feedbacks and resilience in climate modelling [Ocean dynamics, Biosphere dynamics, Cryosphere dynamics]

2. Social tipping points.

Lever of social transformations to accelerate and scale "S-curve" dynamics across sectors/geographies/cultures

3. Avenues to safe and just planetary guardianship

of a stable and resilient Earth system for human development

Market
Forces

Technological
Disruption

Political
Progress

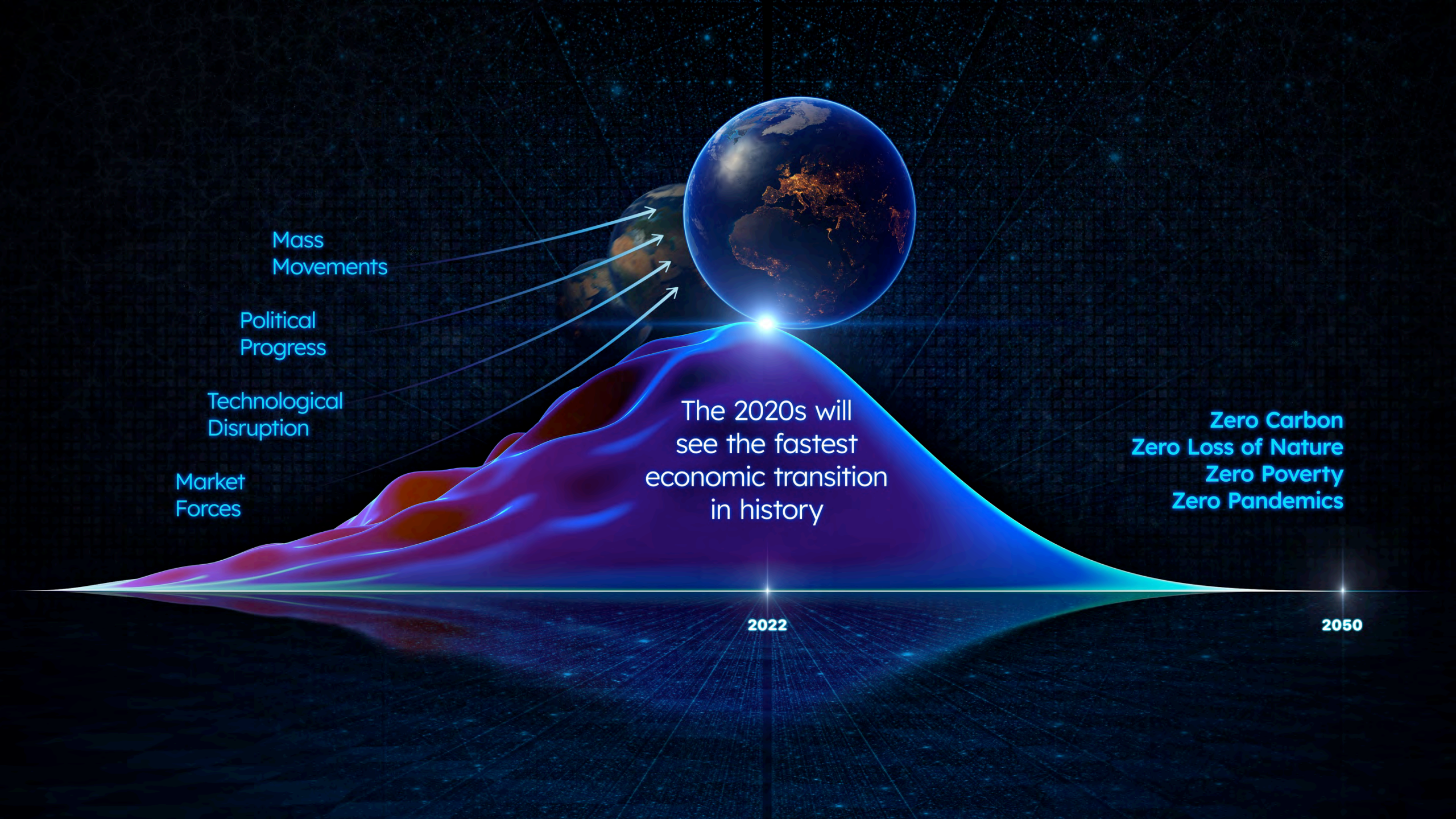
Mass
Movements

The 2020s will
see the fastest
economic transition
in history

Zero Carbon
Zero Loss of Nature
Zero Poverty
Zero Pandemics

2022

2050





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