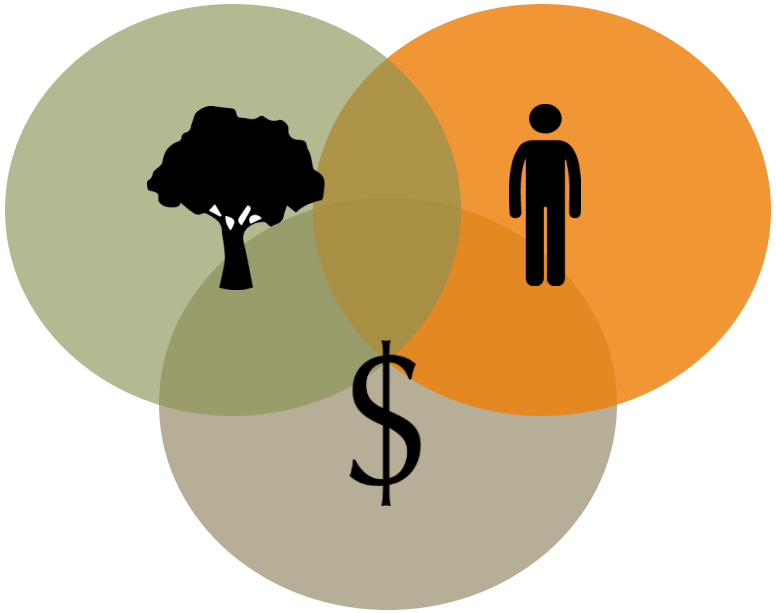



Rosina Bierbaum
Chair, Scientific and Technical Advisory Panel

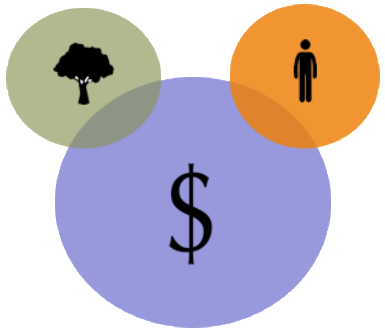
GEF Technical Advisory Group Meeting
February 18, 2025

- New science
- STAP GEF9 perspective

The 3 inter-dependent facets of sustainability




17 PARTNERSHIPS FOR THE GOALS
ECONOMY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
SOCIETY
1 NO POVERTY
11 SUSTAINABLE CITIES AND COMMUNITIES
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
7 AFFORDABLE AND CLEAN ENERGY
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
2 ZERO HUNGER
BIOSPHERE
15 LIFE ON LAND
14 LIFE BELOW WATER
6 CLEAN WATER AND SANITATION
13 CLIMATE ACTION



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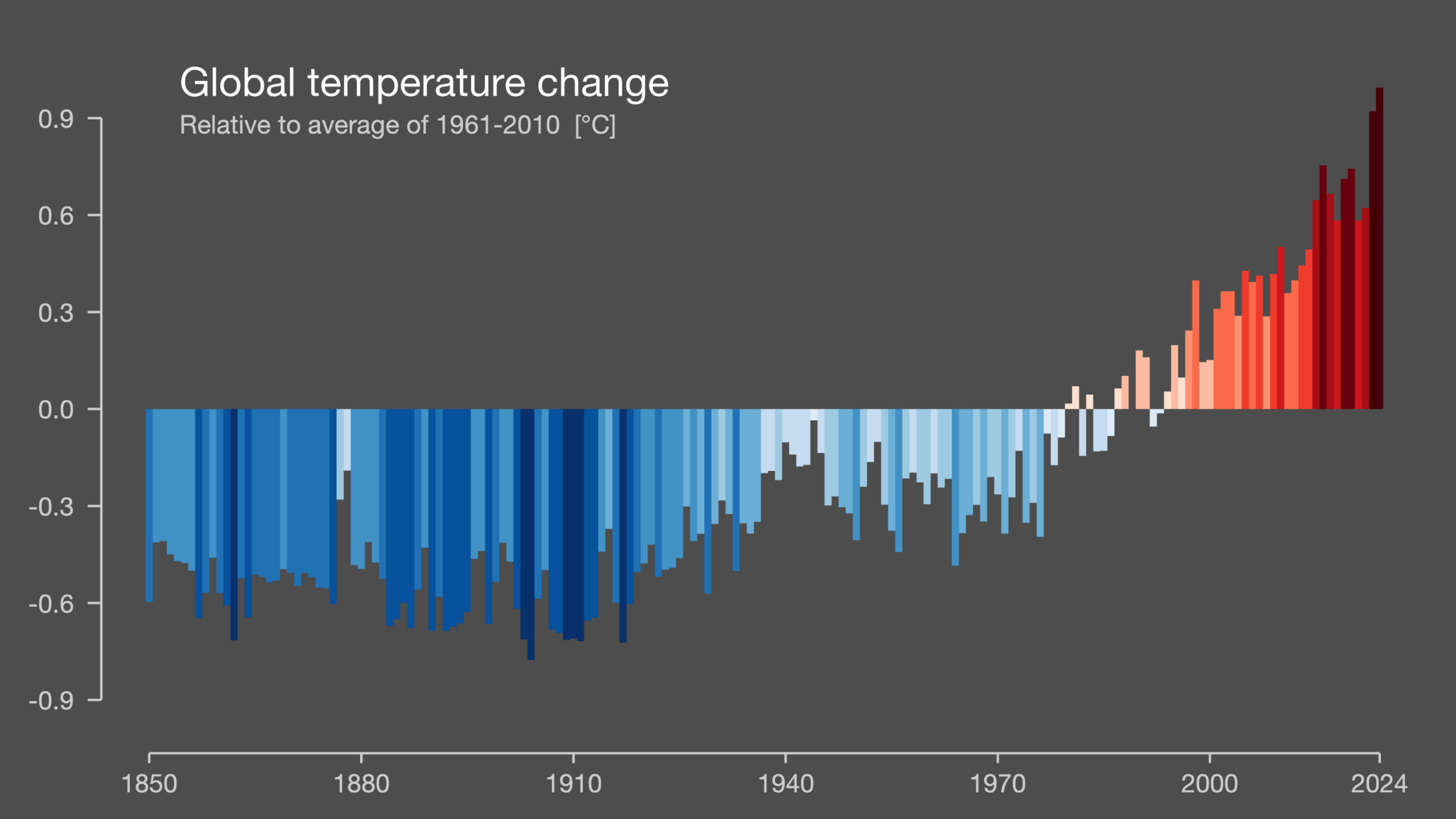
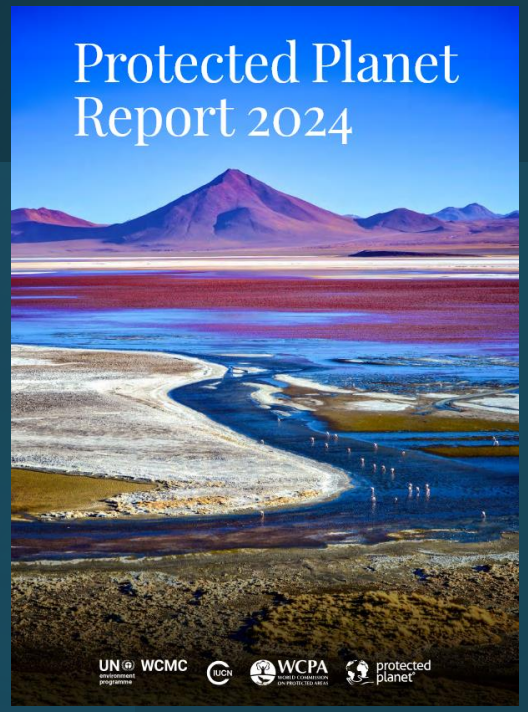
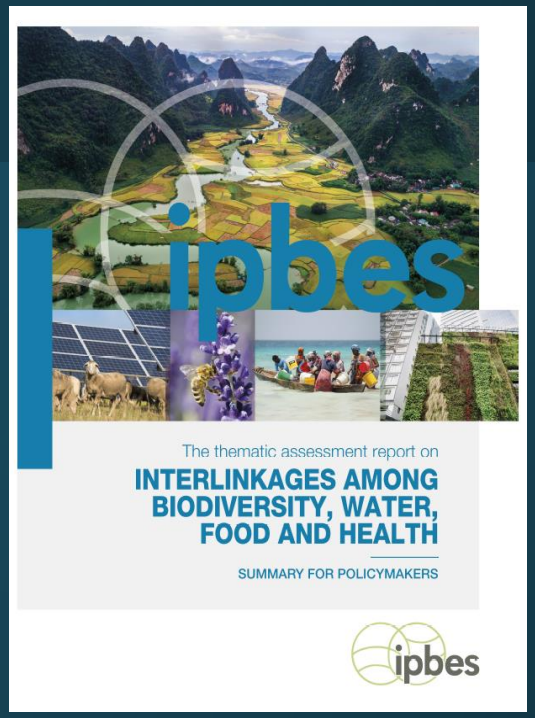
Reconnecting Development with People and Environment

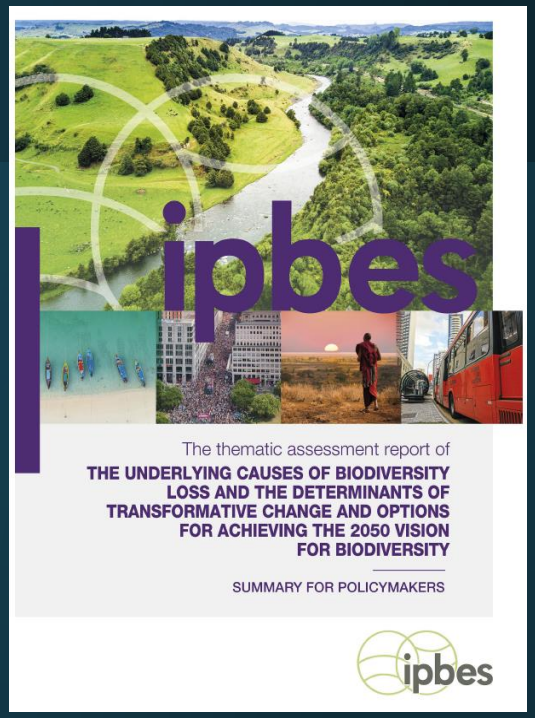
Johan Rockstrom


Global temperature change
Relative to average of 1961-2010 [°C]
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
1850
1880
1910
1940
1970
2000
2024

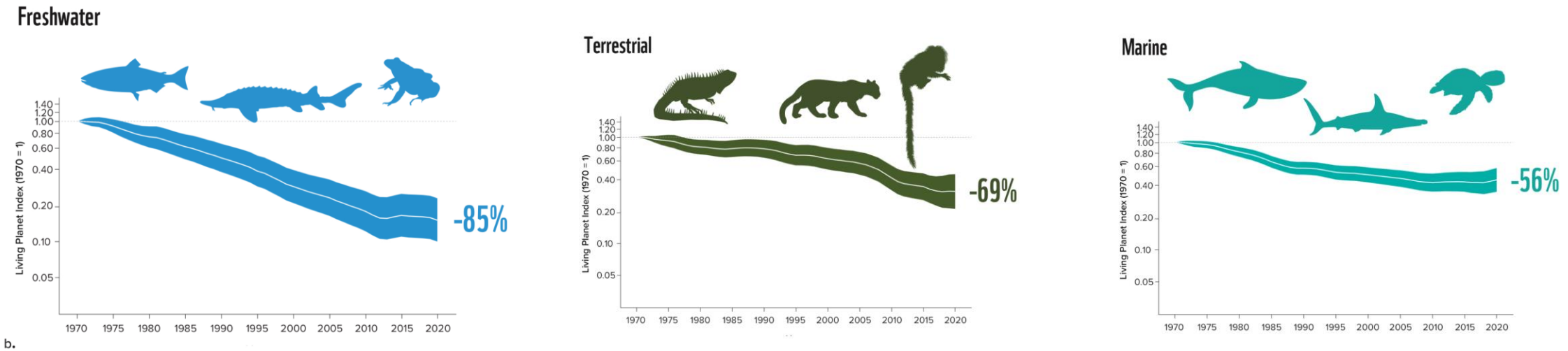
Biodiversity







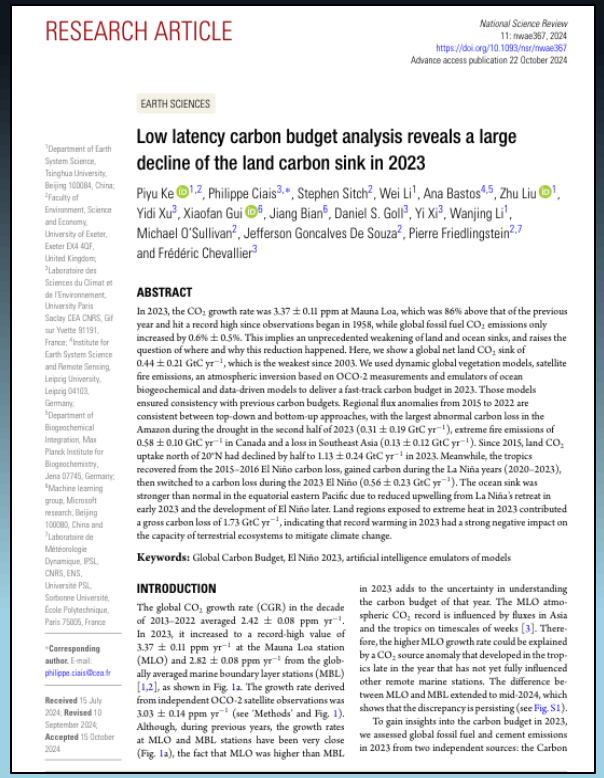
Declines in freshwater species are greatest, followed by terrestrial and marine



WWF & ZSL 2024

An octopus and a fish in the sea toad family discovered in Nazca-Desventuradas Marine Park in Chile, 2024 – Credit: Schmidt Ocean Institute

Land



RESEARCH ARTICLE

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EARTH SCIENCES

Low latency carbon budget analysis reveals a large decline of the land carbon sink in 2023

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ABSTRACT

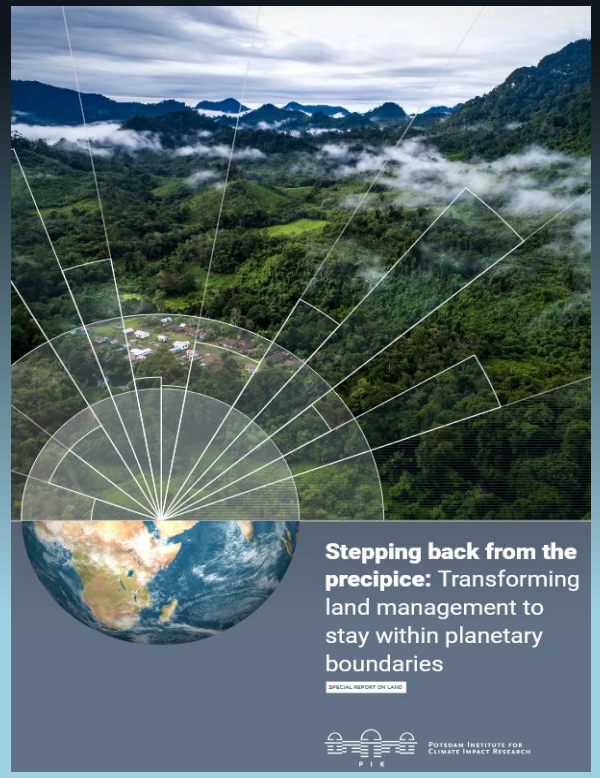
In 2023, the CO_2 growth rate was 3.37 ± 0.11 ppm at Mauna Loa, which was 86% above that of the previous year and hit a record high since observations began in 1958, while global fossil fuel CO_2 emissions only increased by 0.6% ± 0.5%. This implies an unprecedented weakening of land and ocean sinks, and raises the question of where and why this reduction happened. Here, we show a global net land CO_2 sink of 0.44 ± 0.21 GtC yr^{-1}, which is the weakest since 2003. We used dynamic global vegetation models, satellite fire emissions, an atmospheric inversion based on OCO-2 measurements and emulators of ocean biogeochemical and data-driven models to deliver a fast-track carbon budget in 2023. Those models ensured consistency with previous carbon budgets. Regional flux anomalies from 2015 to 2022 are consistent between top-down and bottom-up approaches, with the largest abnormal carbon loss in the Amazon during the drought in the second half of 2023 (0.31 ± 0.19 GtC yr^{-1}), extreme fire emissions of 0.58 ± 0.10 GtC yr^{-1} in Canada and a loss in Southeast Asia (0.13 ± 0.12 GtC yr^{-1}). Since 2015, land CO_2 uptake north of 20°N had declined by half to 1.13 ± 0.24 GtC yr^{-1} in 2023. Meanwhile, the tropics recovered from the 2015–2016 El Niño carbon loss, gained carbon during the La Niña years (2020–2023), then switched to a carbon loss during the 2023 El Niño (0.56 ± 0.23 GtC yr^{-1}). The ocean sink was stronger than normal in the equatorial eastern Pacific due to reduced upwelling from La Niña's retreat in early 2023 and the development of El Niño later. Land regions exposed to extreme heat in 2023 contributed a gross carbon loss of 1.73 GtC yr^{-1}, indicating that record warming in 2023 had a strong negative impact on the capacity of terrestrial ecosystems to mitigate climate change.

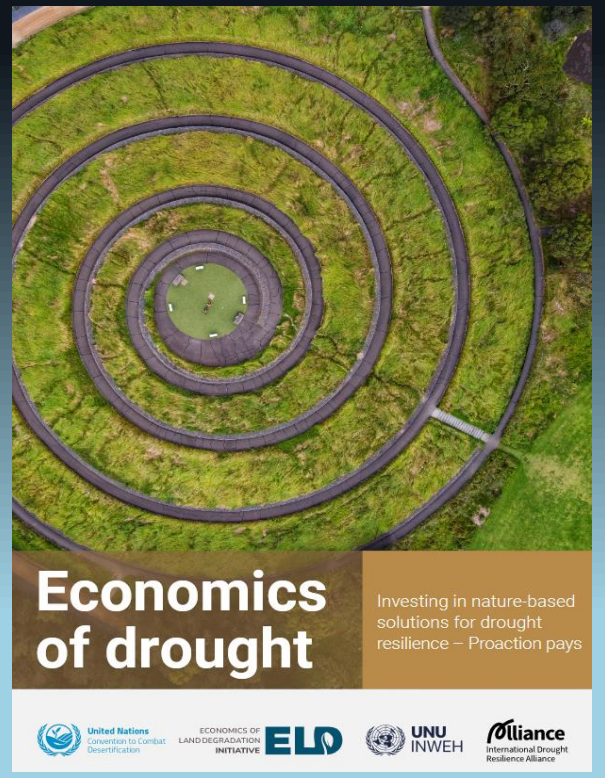
Keywords: Global Carbon Budget, El Niño 2023, artificial intelligence emulators of models

INTRODUCTION

The global CO_2 growth rate (CGR) in the decade of 2013–2022 averaged 2.42 ± 0.08 ppm yr^{-1}. In 2023, it increased to a record-high value of 3.37 ± 0.11 ppm yr^{-1} at the Mauna Loa station (MLO) and 2.82 ± 0.08 ppm yr^{-1} from the globally averaged marine boundary layer stations (MBL) [1,2], as shown in Fig. 1a. The growth rate derived from independent OCO-2 satellite observations was 3.03 ± 0.14 ppm yr^{-1} (see 'Methods' and Fig. 1). Although, during previous years, the growth rates at MLO and MBL stations have been very close (Fig. 1a), the fact that MLO was higher than MBL in 2023 adds to the uncertainty in understanding the carbon budget of that year. The MLO atmospheric CO_2 record is influenced by fluxes in Asia and the tropics on timescales of weeks [3]. Therefore, the higher MLO growth rate could be explained by a CO_2 source anomaly that developed in the tropics late in the year that has not yet fully influenced other remote marine stations. The difference between MLO and MBL extended to mid-2024, which shows that the discrepancy is persisting (see Fig. S1).

To gain insights into the carbon budget in 2023, we assessed global fossil fuel and cement emissions in 2023 from two independent sources: the Carbon





World Economic Forum Global Risk Reports

	1	2	3	4	5
2023	Failure to mitigate climate change	Failure of climate change adaptation	Natural disasters	Biodiversity loss	Large-scale involuntary migration
2024	Extreme weather events	Biodiversity loss and ecosystem collapse	Critical change to Earth systems	Natural resource shortages	Misinformation and disinformation
2025	Extreme weather events	Biodiversity loss and ecosystem collapse	Critical change to Earth systems	Natural resource shortages	Misinformation and disinformation

Global risks ranked by severity over the long term (10 years)

Environmental
Societal
Technological

Source: WEF Global Risk Reports 2023; 2024; and 2025

Transformation...

Transformation require adopting radical and holistic solutions to remodel complex societal, political, economic, and technical structures

– STAP 2022

Actions for transformation:

- Creating enabling conditions
- Directed actions
  - *Geels 2019; Lenton et al. 2022; Lenton et al. 2023*

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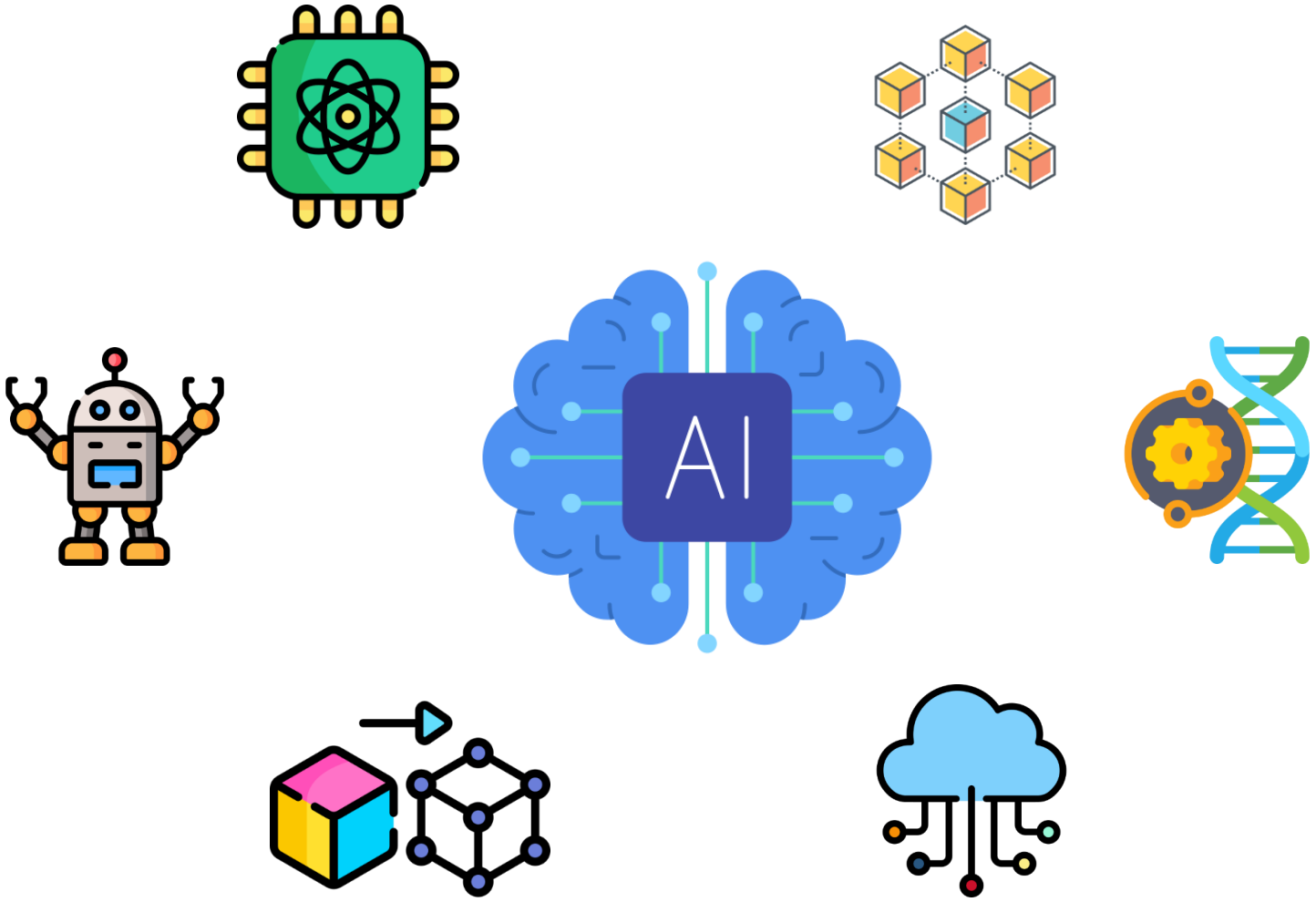
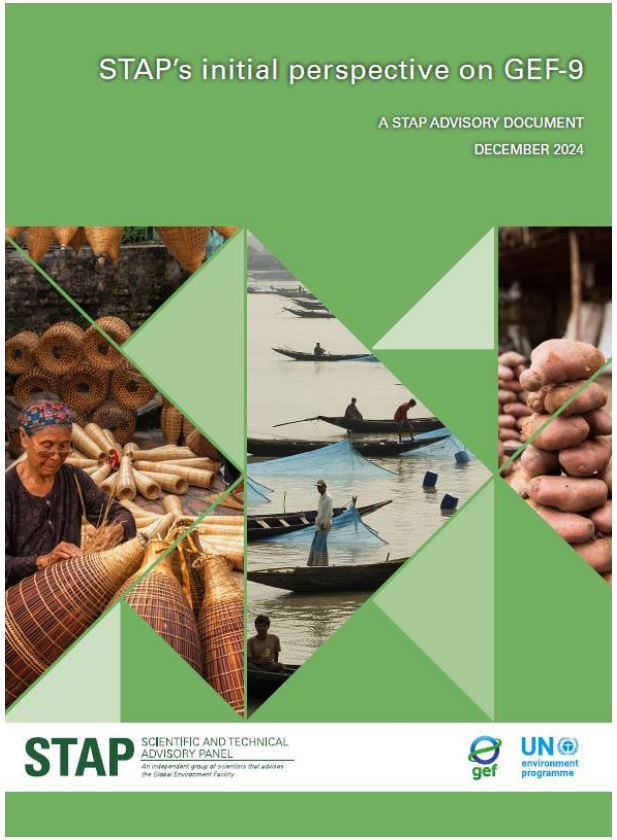
Technological innovation… solution, but…



STAP's initial perspective on GEF-9



Strategic requirements

- Clarity on GEF's specific contributions to systems transformation
- Ambitious but realistic set of targets
- Evidence-based pathways for change grounded in strategic partnerships to address barriers to transformation

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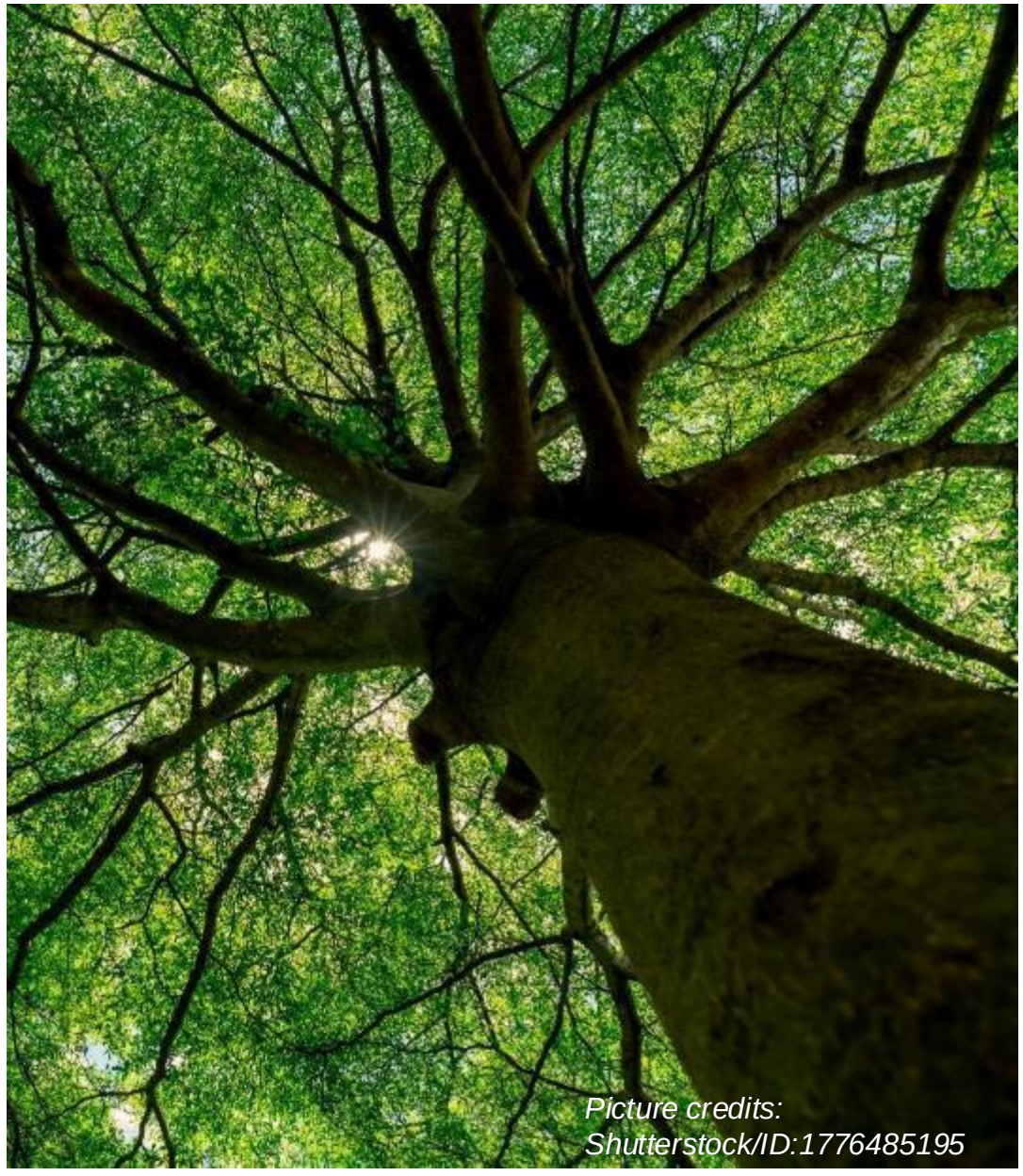
Overview: 7 possible foci for GEF-9



Picture credits: Shutterstock/ID:1776485195

1. Build a GEF theory of change to drive portfolio-wide investment
2. Invest in innovation and manage risk
3. Support policy coherence
4. Enable civil society
5. Work to influence market transformation
6. Revisit the GEF results framework
7. Foster early, adaptive learning, and networked knowledge management

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1. Build an overarching GEF-9 theory of change to drive portfolio-wide investment


Picture credit: tools4dev

- To guide coordination across all the operational levels of the GEF
- Show how the GEF can contribute to transformation in key systems, e.g., food, cities, and forests
- Identify levers for systems transformation

2. Invest in innovation and manage associated risk at the portfolio and program levels

- Define the GEF's role in delivering innovative solutions
- Identify problems requiring innovation, and commission solutions from diverse sources
- Embed innovation in the project and program design cycle
- Be clear about how innovation risks will be managed

Picture credit: Sue Chin, Common marmoset (Callithrix jacchus), Brazil

3. Support policy coherence at multiple levels

Kyle de Nobrega © WCS Nouabalé-Ndoki National Park, Congo

- Strengthen policy coherence through support of policy dialogue, design, and alignment
- Partner with other institutions, like the World Bank, IMF, and regional development banks
- Support interministerial and intersectoral coordination for policy coherence

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4. Enable civil society to strengthen the social foundations for transformation

- Enhance the “whole of society” approach
- Strengthen the role of civil society in project design
- Support capacity building for civil society
- Empower IPLCs

© Everland, Keo Seima Wildlife Sanctuary, Cambodia

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5. Work to influence market transformation in targeted sectors

Scott Ramsay© WCS Nouabalé-Ndoki National Park, Congo

- Strengthen national policy and the regulatory environment
- Build capacity to attract sustainable private finance
- Leverage the influence of other financial institutions
- Ensure that blended finance projects give equal weight to environmental and financial benefits

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6. Revisit the GEF results framework

- Adopt lead indicators for transformation to measure the GEF's contributions
- Capture socio-economic and adaptation co-benefits
- Consider whether core indicators are sufficiently focused on environmental outcomes

Picture credit: Erika Piñeros©, Wasini Island, Kenya

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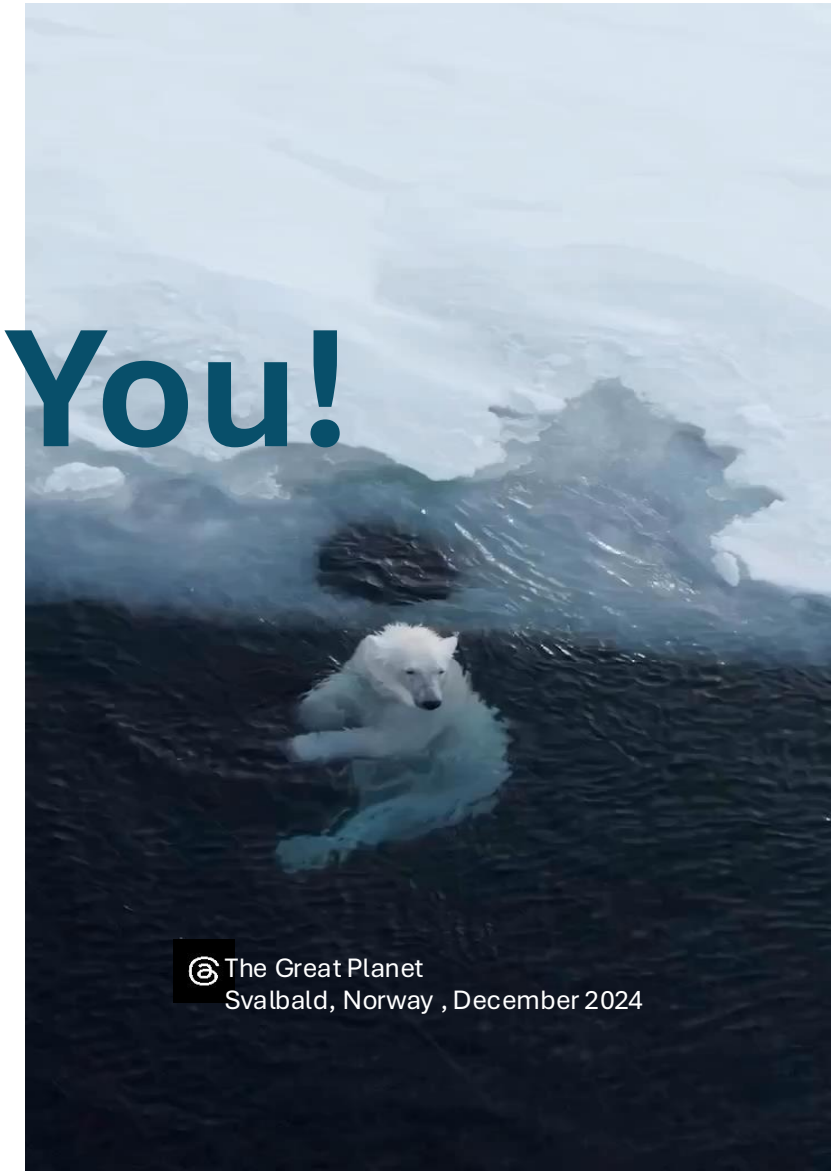
7. Foster early and adaptive learning, and networked knowledge management

Picture credit: Sigit Deni Sasmito, Indonesia

- Early capture of what works and what doesn't, why, how, and in what context
- A more dynamic system of monitoring, evaluation, and learning
- Assess current programs to inform future strategy; learn from past projects
- KM&L systems should be integrated, open, and networked.


Science
Advances
31 JANUARY 2025
AAAS

Thank You!


The Great Planet
Svalbald, Norway , December 2024