European Pavilion

Digital Ocean

Nice | France

2 - 13 JUNE 2025

Ocean & Climate: sustainable development

12. June 2024

Inspire

ocean & climate

Inspire
ocean & climate

Hans-Otto Pörtner

Alfred-Wegener-Institute, Bremerhaven, Germany

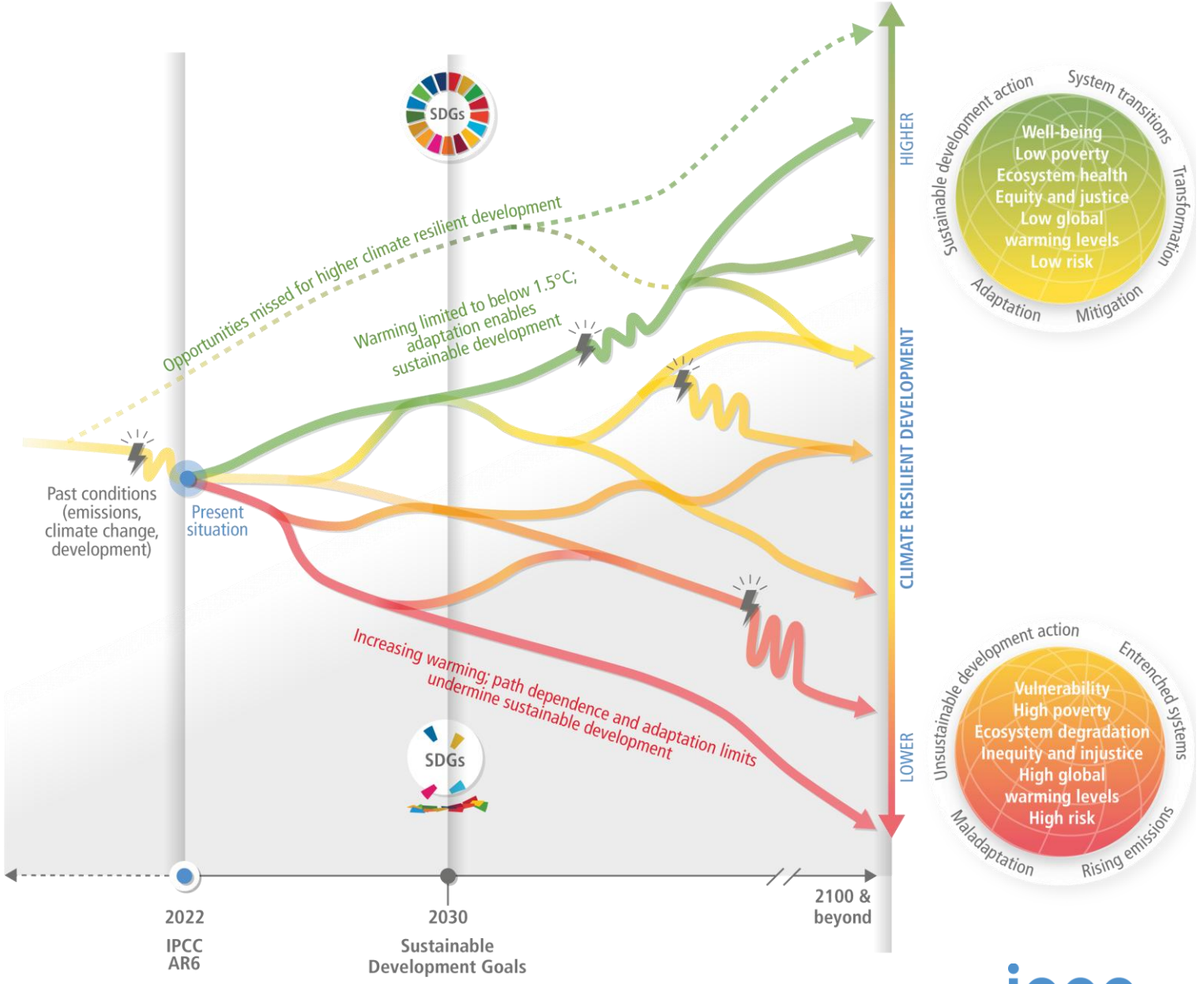
IPCC WGII Co-Chair AR6

The ocean in climate resilient futures: preconditions

Climate Resilient Development of ecosystems and societies through system transitions,

IS URGENT

and a precondition for reaching sustainability (SDGs)



Illustrative climatic or non-climatic shock, e.g. COVID-19, drought or floods, that disrupts the development pathway

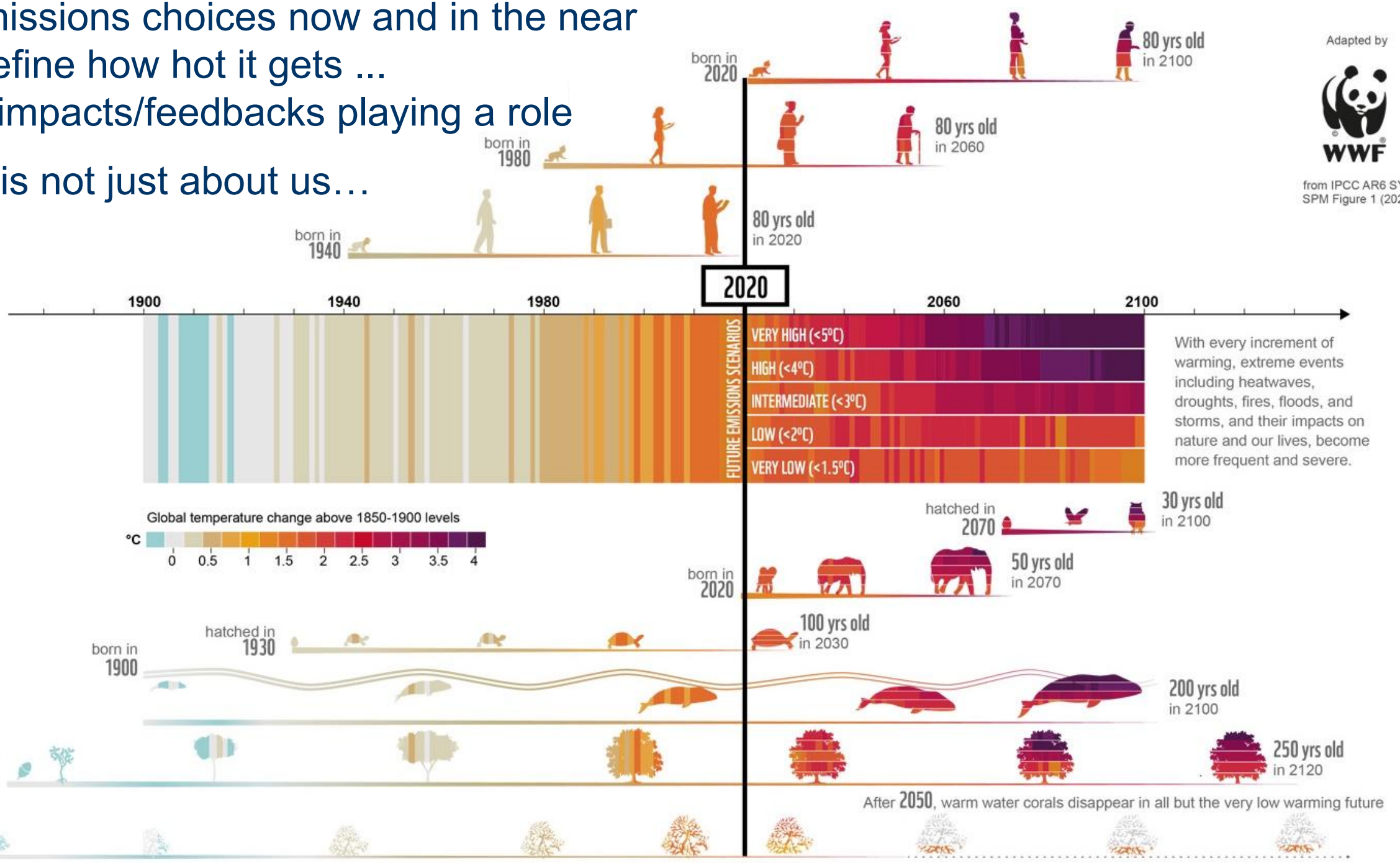
Narrowing window of opportunity for higher CRD

WGII AR6 Main Report and SYR

Inspire ocean & climate

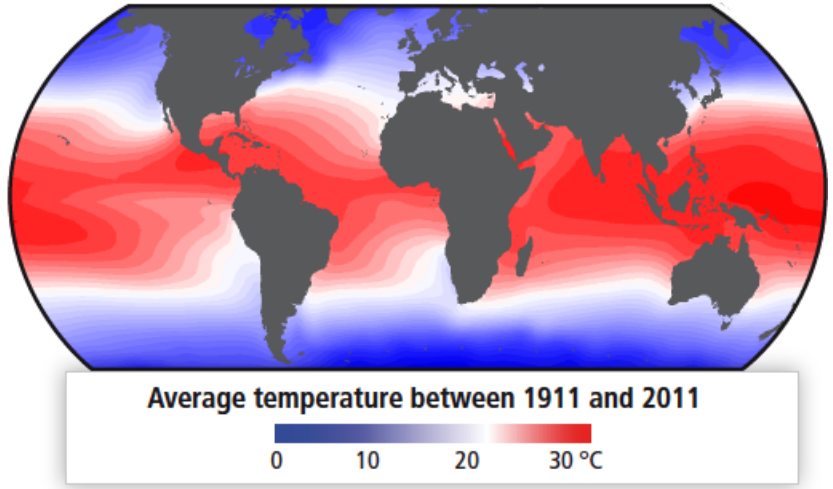
Our emissions choices now and in the near term define how hot it gets ...
ocean impacts/feedbacks playing a role

And it is not just about us…

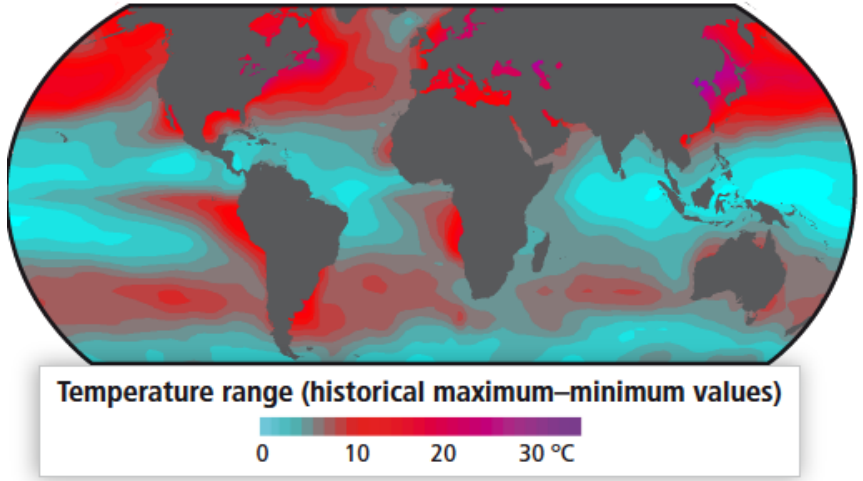


Risks and Guidelines to be considered for Ocean and Climate Resilience and Sustainability

Warming, Acidification, expanding Hypoxia
occur on top of and change regional and natural variability:
➔ Organism and ecosystem functional changes depending on climate zone



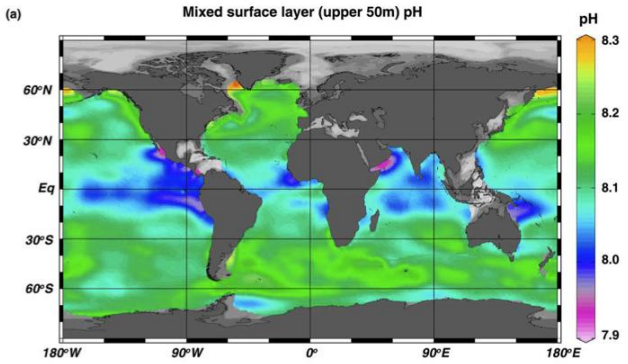
warming



Pörtner et al. 2014

true also for:

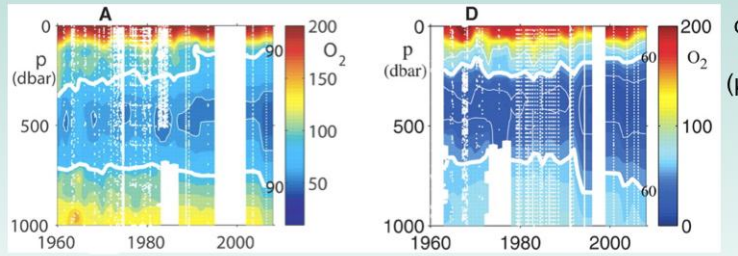
progressive acidification



In ocean surface layers

(Pelejero et al., 2010)

expanding oxygen minimum zones



(A) Eastern tropical North Atlantic (10° to 14°N, 20° to 30°W)

(D) Eastern equatorial Pacific Ocean (5°S to 5°N, 105° to 115°W)

(Stramma et al., 2008)

light, nutrients, food

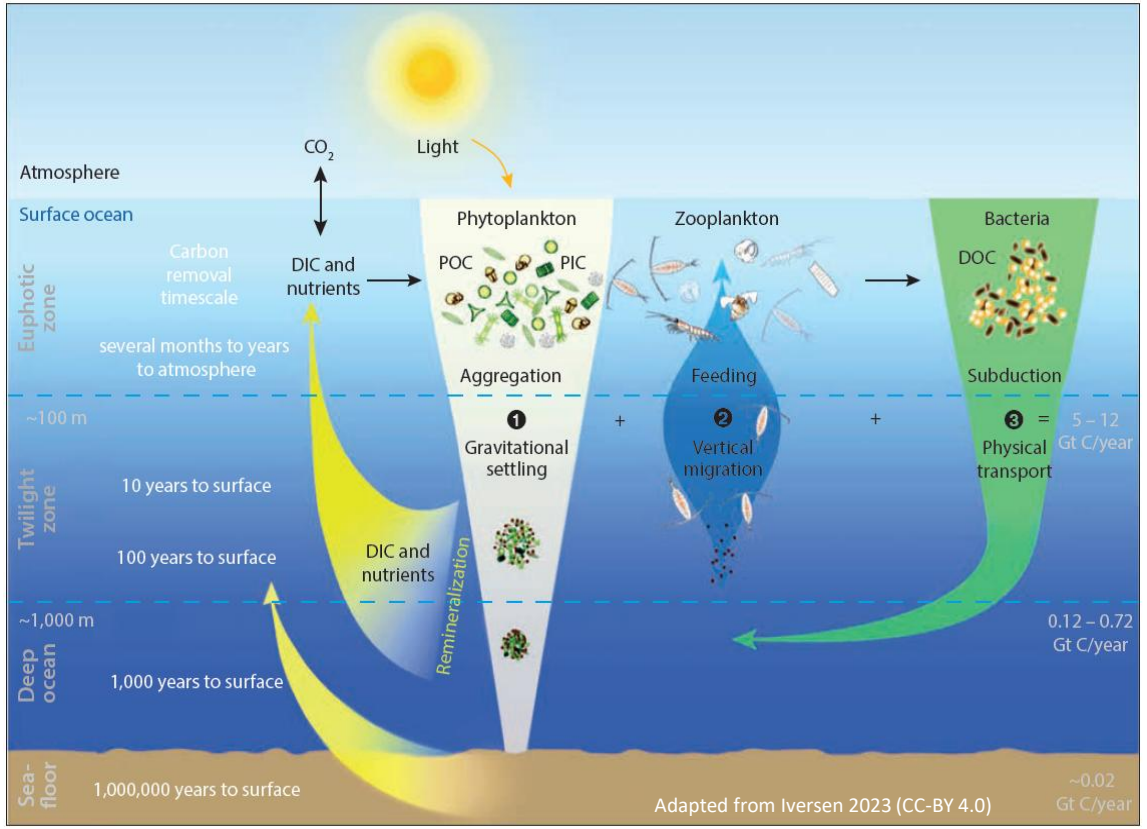
The role of the Ocean in the carbon cycle

European MARINE BOARD
Advancing Seas & Ocean Science

The Biological Carbon Pump (BCP)

Transport of organic carbon from surface to deep Ocean through settling and export

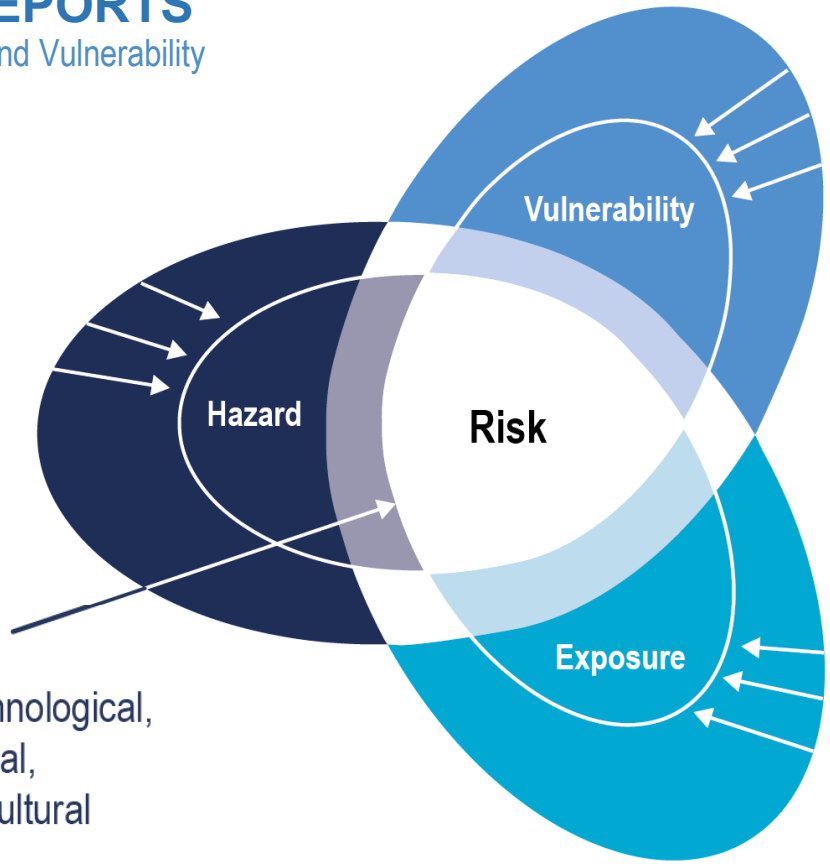
- is mainly driven by phytoplankton converting CO_2 into organic carbon through **photosynthesis**
  - ➢ Carbon is transferred to other animals through food-webs, esp. to fish and whales
- Only a small proportion reaches **deeper waters** where it can be stored for 100-1,000 years
- An even smaller proportion is stored in **sediments** for up to millions of years



The BCP Includes all living organisms that move carbon around the Ocean

→The BCP helps in building Blue Carbon ecosystems, but its yearly contribution is very small

Evaluating risks and guidelines for resilience and sustainability



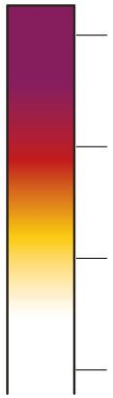
The IPCC concept of risk

Climate action entails risk reduction by adaptation and mitigation …. considering limits to adaptation

Limits to Adaptation

- E.g. physical, ecological, technological, economic, political, institutional, psychological, and/or socio-cultural

Level of added impacts/risks



- **Very high** — **Purple:** Very high probability of severe impacts/ risks and the presence of significant irreversibility or the persistence of climate-related hazards, combined with persistence of climate-related hazards, combined with limited ability to adapt due to the nature of the hazard or impacts/risks.
- **High** — **Red:** Significant and widespread impacts/risks.
- **Moderate** — **Yellow:** Impacts/risks are detectable and attributable to climate change with at least medium confidence.
- **Undetectable** — **White:** Impacts/risks are undetectable.

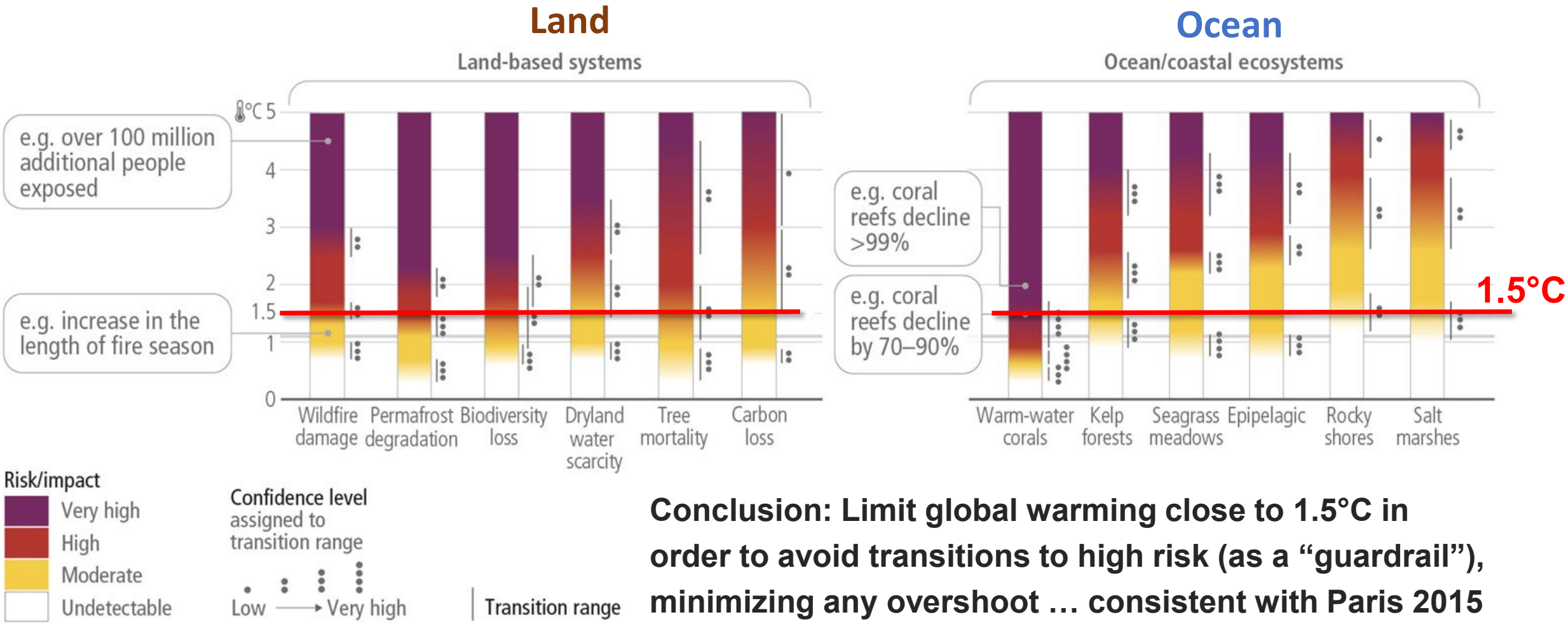
Confidence level for transition

●●●● = Very high
●●● = High
●● = Medium
● = Low
| = Transition range

**see figure caption for definition

[IPCC SROCC, WGII AR6]

Risks for nature and, consecutively, humans …
… warm water coral reefs: a special system already at high risk

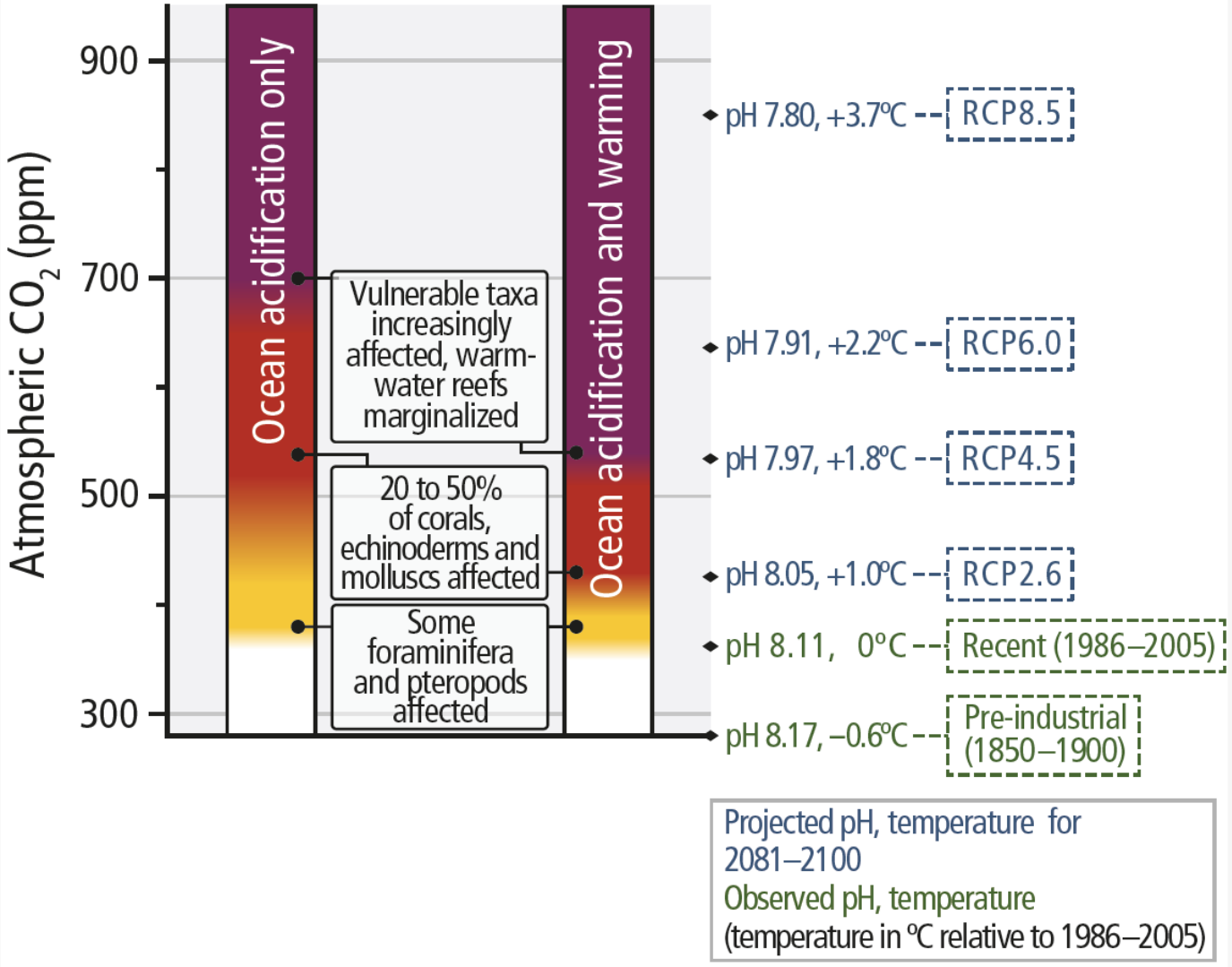


Conclusion: Limit global warming close to 1.5°C in order to avoid transitions to high risk (as a "guardrail"), minimizing any overshoot … consistent with Paris 2015

IPCC AR6 SYR Figure SPM.4b

Increasing risk from RCP2.6 to RCP8.5

(b) Risk for marine species impacted by ocean acidification only, or additionally by warming extremes



… exacerbation of impacts and risks under combined ocean warming and acidification

…also under combined ocean warming and oxygen loss

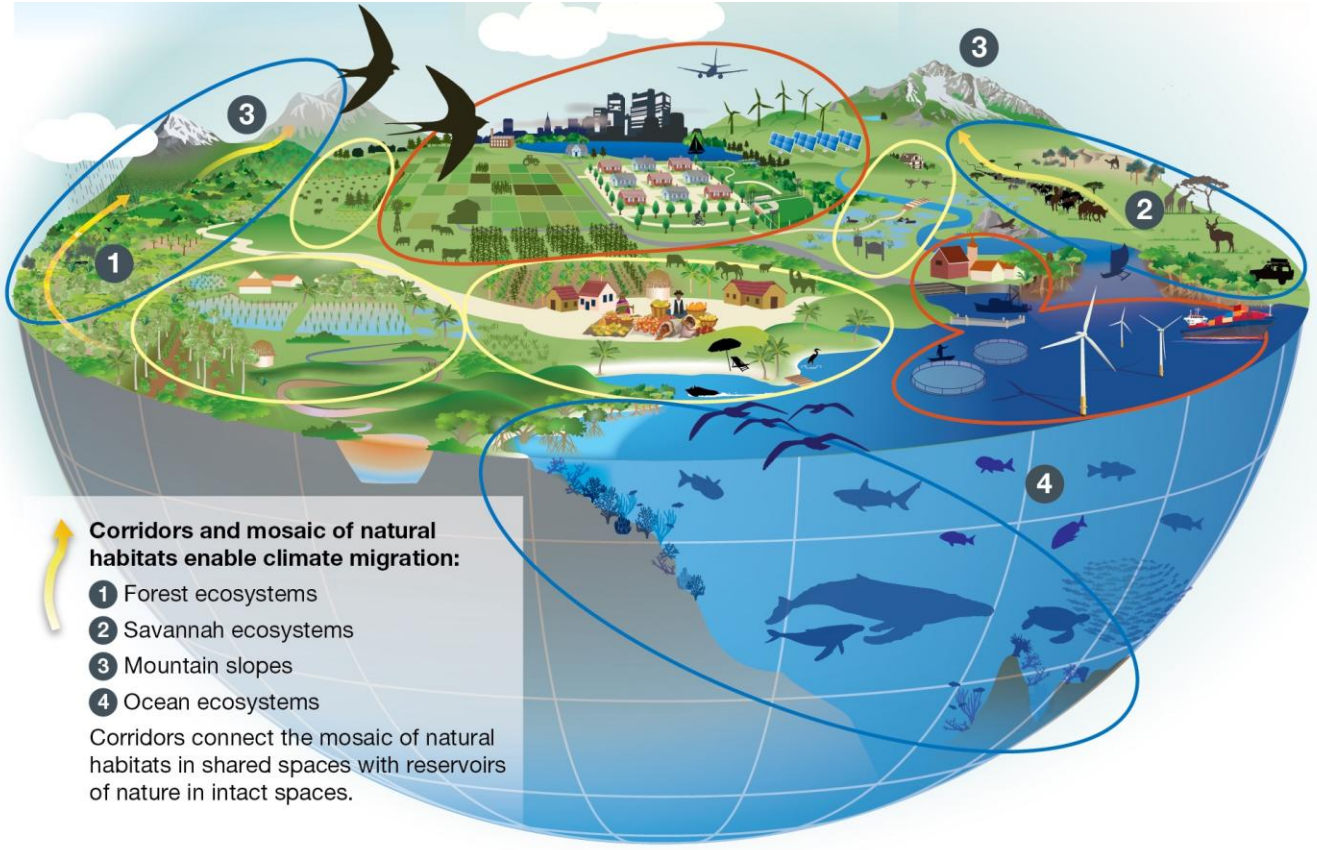
…and under the „deadly trio“

Deutsch et al., Science 2015, Reddin et al. Nature Climate Change 2020, Sampaio et al. Nature Ecology and Evolution 2021

IPCC SYR AR5

ipcc
INTERGOVERNMENTAL PANEL ON Climate change

Risk reduction through resilience building …. supported by mosaic land-, sea- and freshwater spatial planning



- Quantify effective and ecosystem-specific needs
- Include species migration corridors
- Sustain gradients between well protected and used spaces
- Implement effective and socially just protection measures to restore biodiversity on 30-50% of Land-, Freshwater and Ocean systems
- Restore Planetary Health, with climate resilient ecosystem services (Nature‘s contributions to people)

Conclusions: Stating the obvious …

- Solutions of the climate and the biodiversity crises depend on each other, also in the ocean, (…excluding chemical manipulation of the ocean at global scale, for climate mitigation.)
- A holistic concept (Climate Resilient Development, CRD) integrates mitigation, adaptation, development, loss and damage, and climate resilient biodiversity.