Natural Hazards and Disaster

Lab 11: Impacts of Modern Global and Climate Change

- Impacts
- Questions

What are the
Impacts of
Climate Change?

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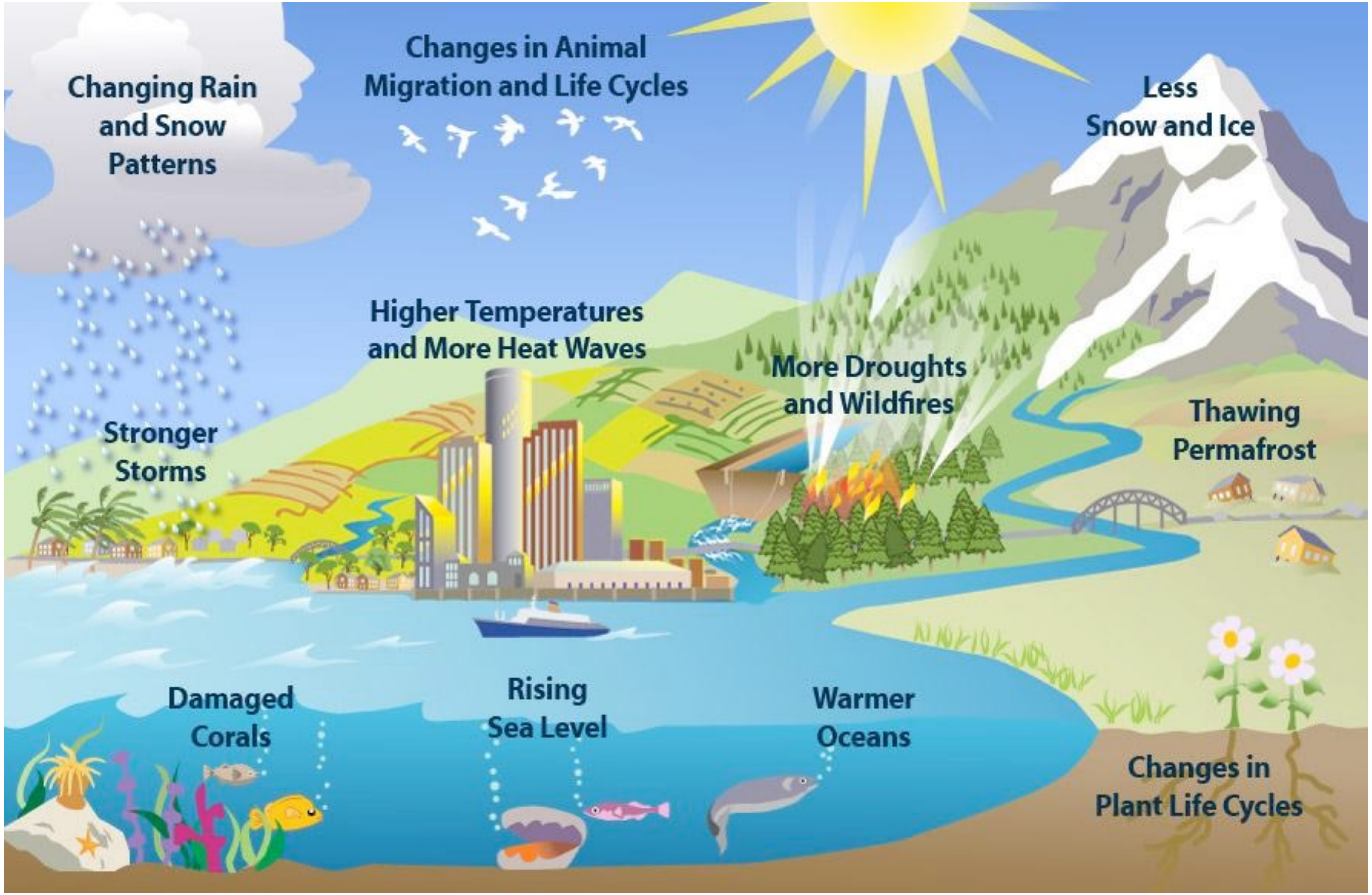
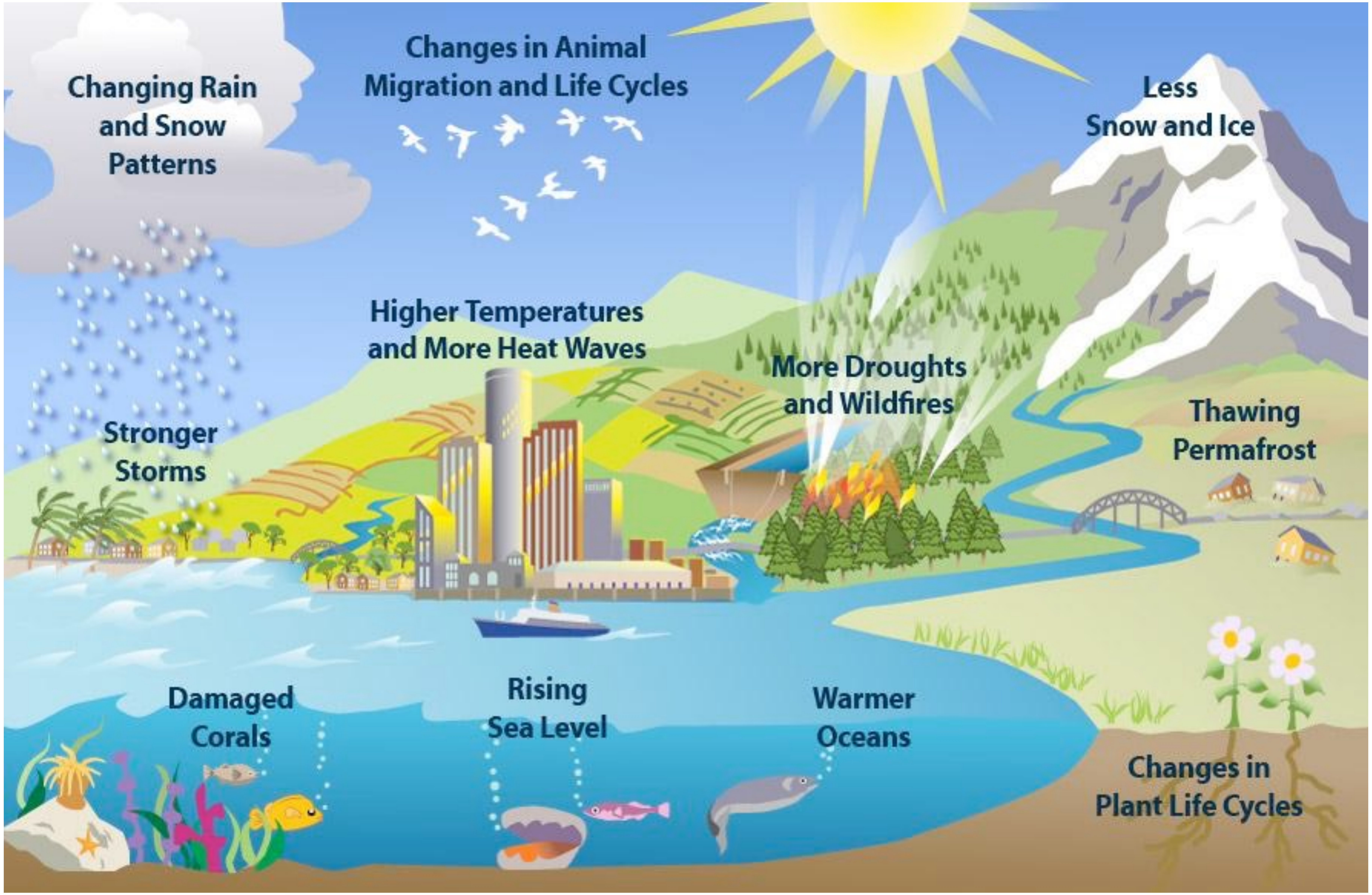
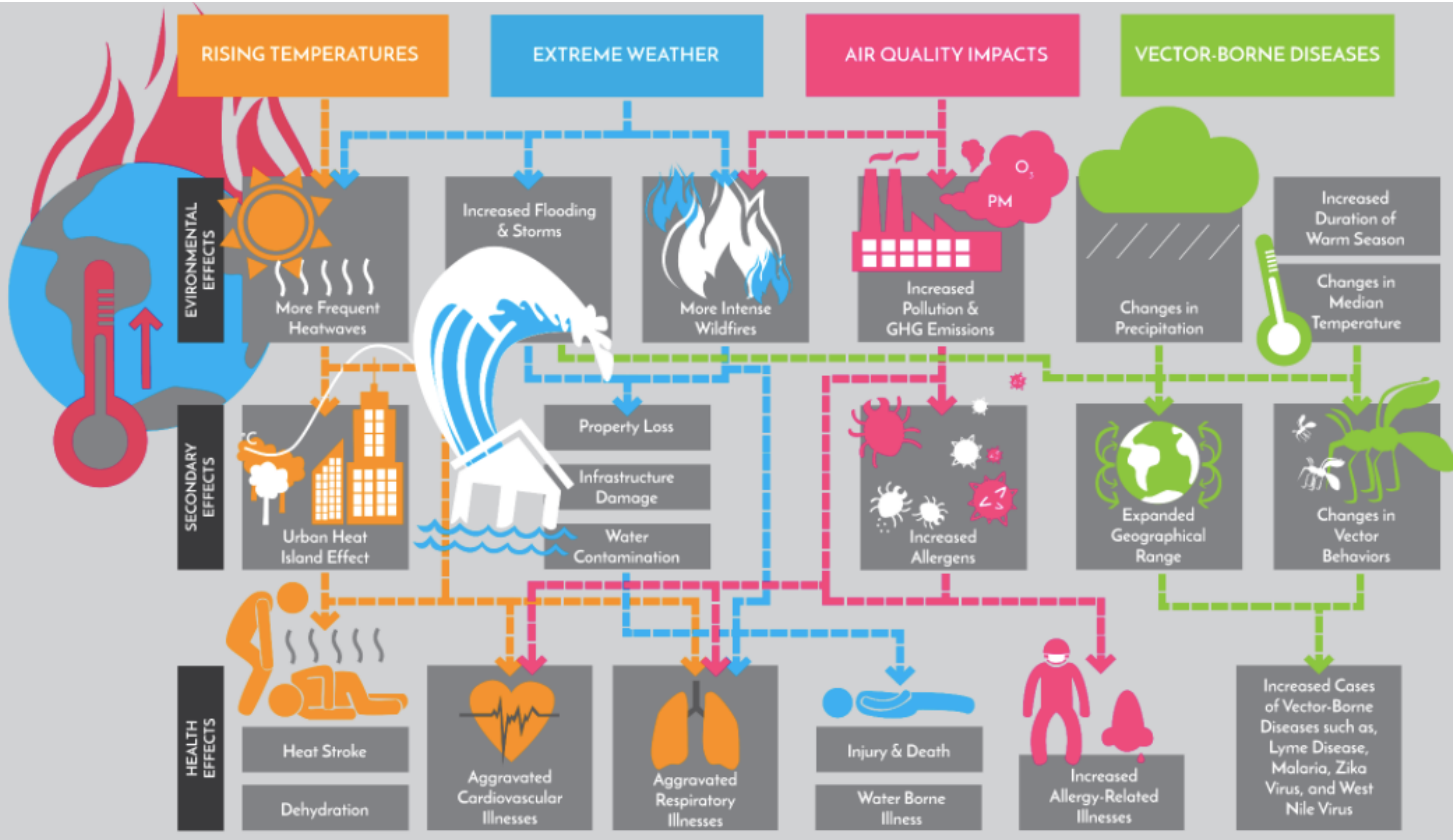


What are the Impacts of Climate Change?

... and there is more:
- health
- supply chains
- mass extinction
- water security
- food security
- migration
- social unrest
...

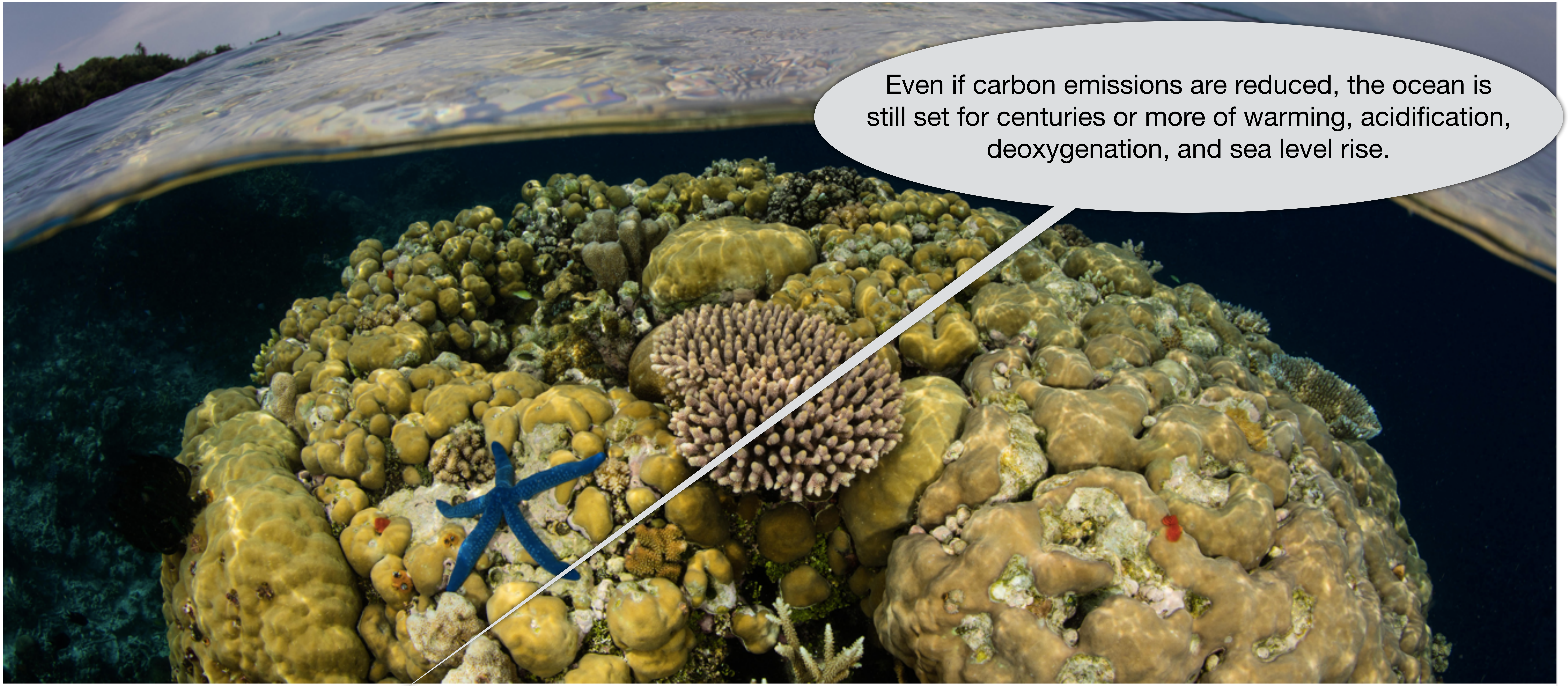


Impacts



RISING TEMPERATURES
EXTREME WEATHER
AIR QUALITY IMPACTS
VECTOR-BORNE DISEASES
EVIRONMENTAL EFFECTS
More Frequent Heatwaves
Increased Flooding & Storms
More Intense Wildfires
Increased Pollution & GHG Emissions
O3
PM
Changes in Precipitation
Increased Duration of Warm Season
Changes in Median Temperature
SECONDARY EFFECTS
°C
Urban Heat Island Effect
Property Loss
Infrastructure Damage
Water Contamination
Increased Allergens
Expanded Geographical Range
Changes in Vector Behaviors
HEALTH EFFECTS
Heat Stroke
Dehydration
Aggravated Cardiovascular Illnesses
Aggravated Respiratory Illnesses
Injury & Death
Water Borne Illness
Increased Allergy-Related Illnesses
Increased Cases of Vector-Borne Diseases such as, Lyme Disease, Malaria, Zika Virus, and West Nile Virus

Impacts



Even if carbon emissions are reduced, the ocean is still set for centuries or more of warming, acidification, deoxygenation, and sea level rise. Photo by Ethan Daniels/Alamy Stock Photo

When It Comes to Climate Change, the Ocean Never Forgets

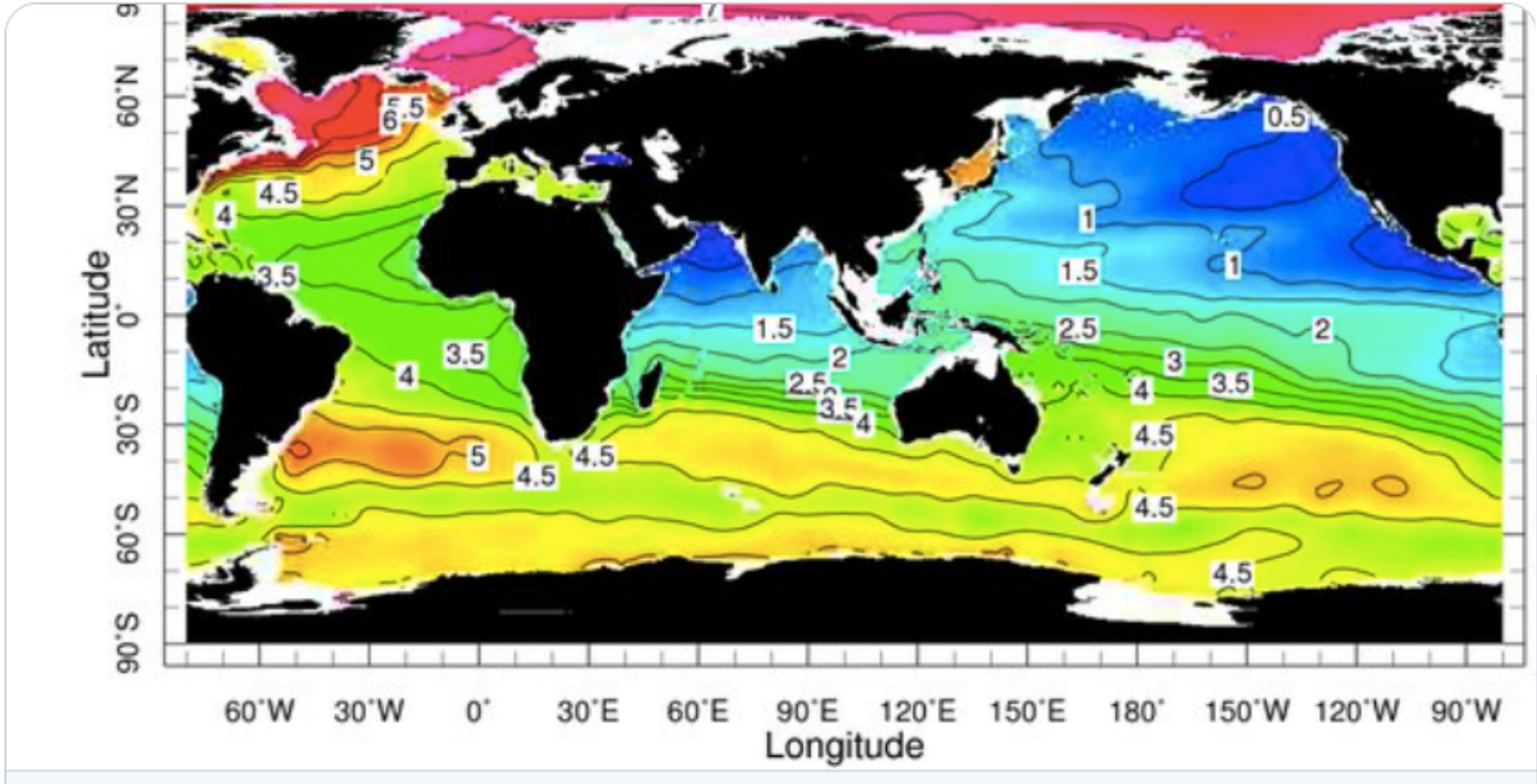
Impacts

REPORT

Large-scale ocean deoxygenation during the Paleocene-Eocene Thermal Maximum

Weiqi Yao[1,*], Adina Paytan[2], Ulrich G. Wortmann[1]
+ See all authors and affiliations

Science 24 Aug 2018:
Vol. 361, Issue 6404, pp. 804-806
DOI: 10.1126/science.aar8658



Fishin' gone?

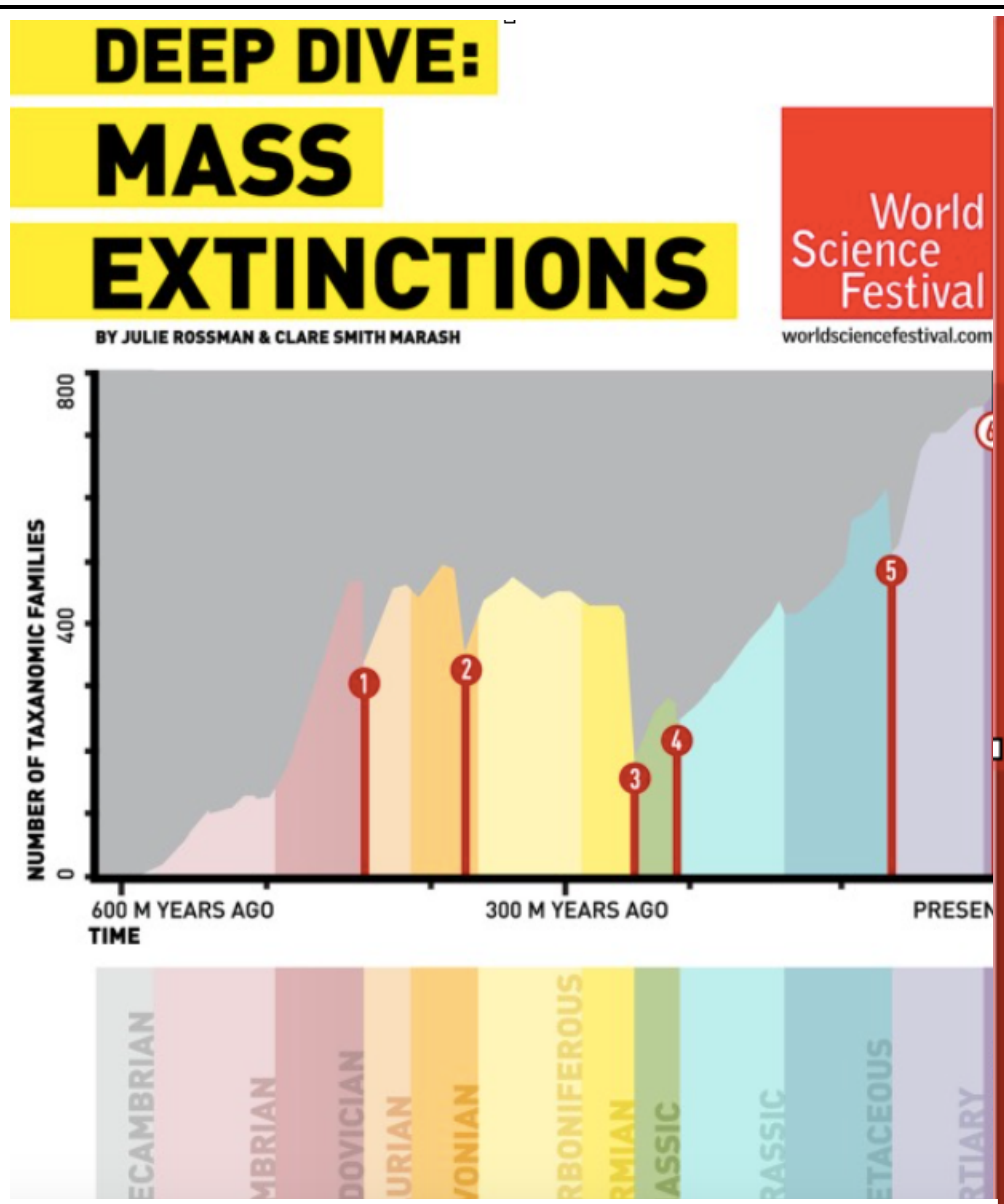
Because gas solubility decreases as temperatures increase, global warming is likely to cause oxygen loss from the oceans. This could have a detrimental impact on fish populations, the fishing industry, and global food availability. Have such impacts occurred before? Yao *et al.* report sulfur isotopic data from the Paleocene-Eocene Thermal Maximum, an interval around 55 million years ago when atmospheric carbon dioxide concentrations and global temperatures were also high. They found widespread anoxia and resulting high concentrations of hydrogen sulfide, which is toxic to marine organisms. Similar effects could have severe negative effects on ocean ecosystems.

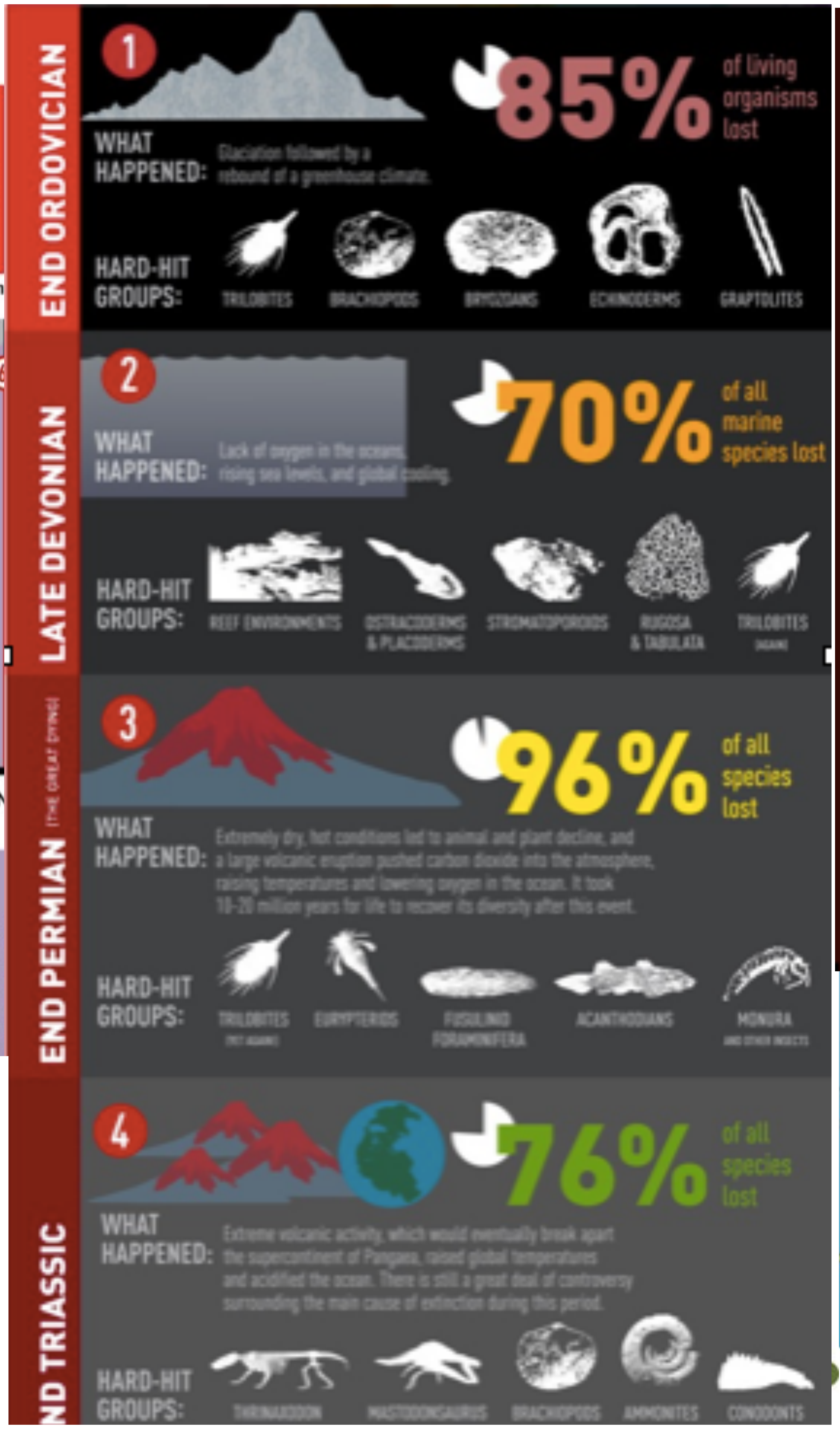
Science, this issue p. 804

Abstract

The consequences of global warming for fisheries are not well understood, but the geological record demonstrates that carbon cycle perturbations are frequently associated with ocean deoxygenation. Of particular interest is the Paleocene-Eocene Thermal Maximum (PETM), where the carbon dioxide input into the atmosphere was similar to the IPCC RCP8.5 emission scenario. Here we present sulfur-isotope data that record a positive 1 per mil excursion during the PETM. Modeling suggests that large parts of the ocean must have become sulfidic. The toxicity of hydrogen sulfide will render two of the largest and least explored ecosystems on Earth, the mesopelagic and bathypelagic zones, uninhabitable by multicellular organisms. This will affect many marine species whose ecozones stretch into the deep ocean.

Impacts





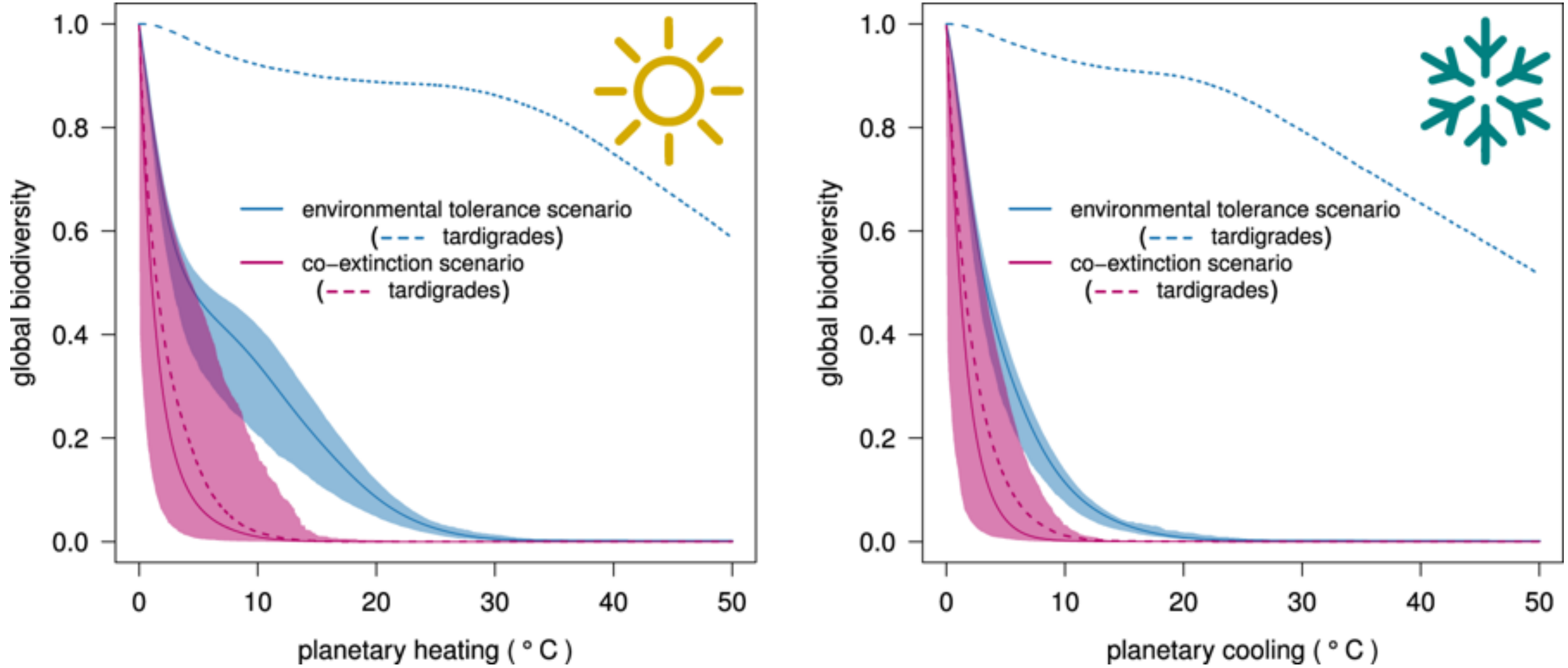
Freshwater: 81%
since 1970

Current extinction rates:

300 times background rate for birds

80,000 times background rate for mammals

Impacts

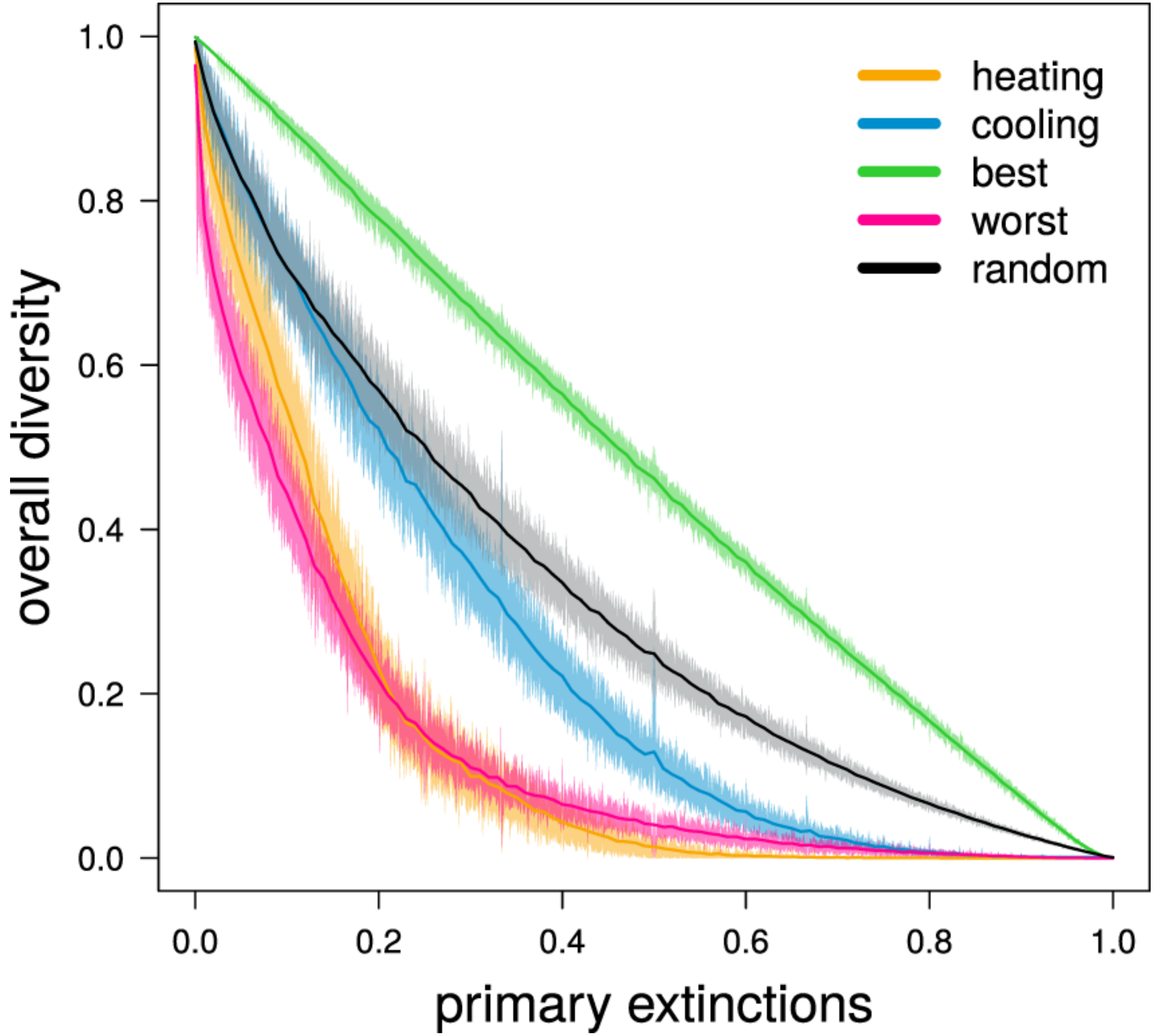


Co-extinctions reduce the robustness of planetary life to catastrophe. Response of global diversity to environmental change: progressive, monotonic increase ('planetary heating'; left panel) or decrease ('planetary cooling'; right panel) trajectories in local temperature. Species either go extinct based only on their tolerance to environmental conditions ('environmental tolerance' scenarios = blue curves), or where species go extinct not only when unable to cope with changed environmental conditions, but also following the depletion of their essential resources ('co-extinction' scenarios = magenta curves). Solid lines represent mean values, and shaded areas indicate the system boundaries (minimum-maximum) arising from 1000 randomly parametrized models (see Methods for details). Dotted lines show the decline in 'tardigrade' (extremophile) species richness in the environmental tolerance (blue) and in the co-extinction scenario (magenta) for both temperature trajectories.

Strona and Bradshaw, 2018

https://www.nature.com/articles/s41598-018-35068-1

Impacts

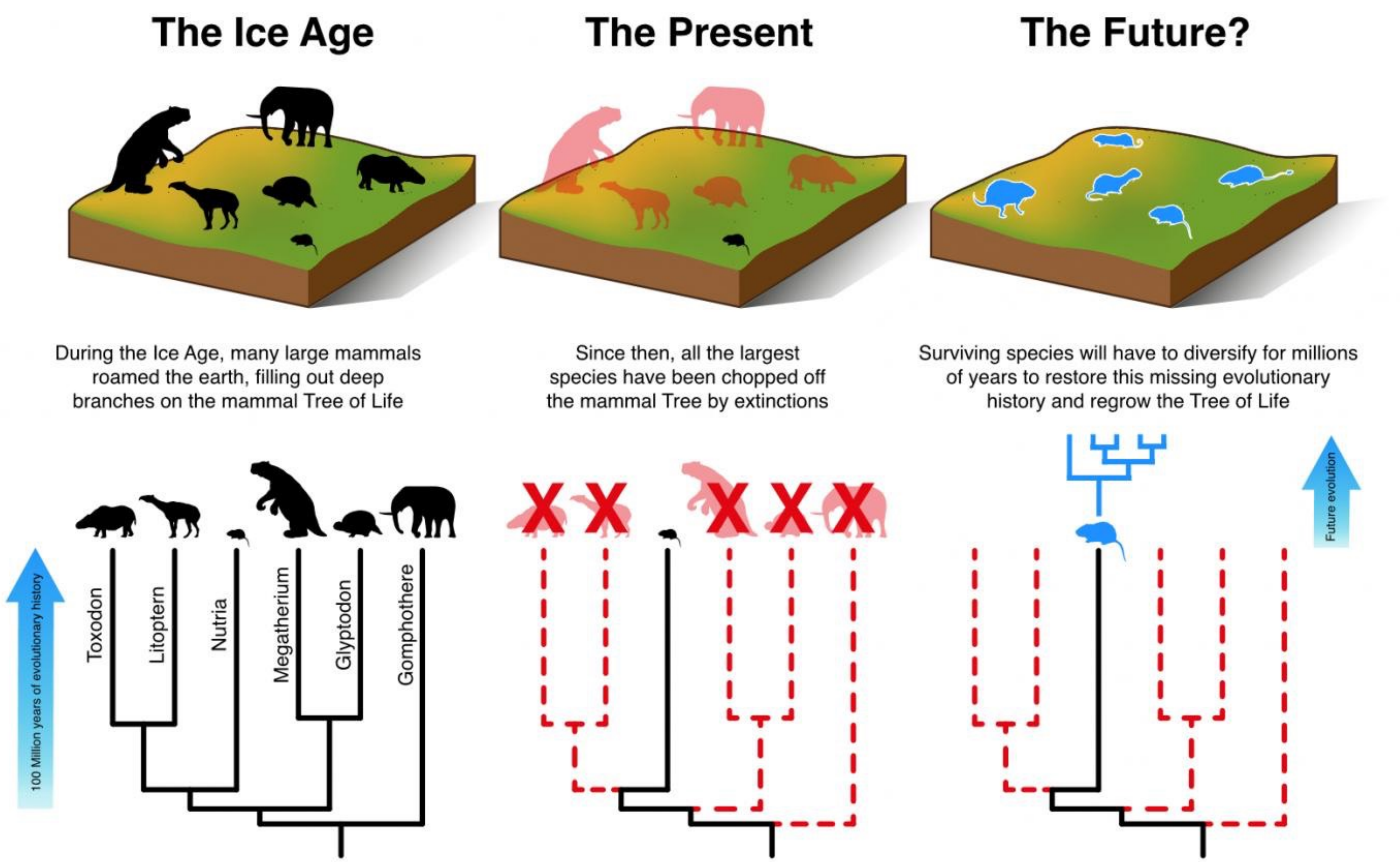


Co-extinctions reduce the robustness of planetary life to catastrophe. Response of global diversity to environmental change: progressive, monotonic increase ('planetary heating'; left panel) or decrease ('planetary cooling'; right panel) Simulated food webs are more robust to global cooling than to heating. We evaluated robustness by 'disassembling' a random sample of 1000 food webs. Disassembly consisted of removing species progressively from the least to the most tolerant to warm ('heating') or cold ('cooling') temperatures. We simulated co-extinctions after each species removal, and then plotted the curves depicting the (co-extinction driven) decline of local diversity following direct species removal. To obtain approximate upper and lower boundaries of robustness, we did two additional disassembly simulations for each food web by removing species in increasing ('best') or decreasing ('worst') order of their expected contribution to network persistence (measured as the number of associated resources per species). For each food web, we also obtained a reference curve by removing species in random order ('random'). Solid lines represent mean values, while shaded areas indicate 99% confidence intervals.

Strona and Bradshaw, 2018

https://www.nature.com/articles/s41598-018-35068-1

Impacts



Davis et al., 2018

Impacts

$$X = \frac{\delta E}{E}\left(1 - \frac{U}{U + I}\right)$$

X: X-ness (extreme nature of the event)
E: ensemble
dE: Change/loss of ensemble
U: Unfolding time
I: Impact time

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Extinction of mammals:
E: all mammal species
dE: Species that go extinct
dE/E = 0.8
U = 300 years
I = 5,000,000 years

X = 0.79995 ~ 0.8

Impacts

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Extinction of mammals has a very high X-ness

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Questions

1 How do the changes in global average surface temperature over the last five decades compare to previous variations in global surface temperature? In which region did the surface temperature change most?

Thoughts:

Questions

2 What are the three main drivers that determine Earth's climate and which of them have changed a lot during the last few decades? Describe the changes.

Thoughts:

Questions

3 The earth is currently storing on the order of 320 TW of additional energy. Where is this energy being stored and what are the potential impacts of this additional energy?

Thoughts:

Questions

4 What is the range of global average sea level change expected by 2100 and what contributes most to making this range large? What is the maximum sea level rise that we cannot safely exclude?

Thoughts: