

Impacts on Ecosystems

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Ecosystems



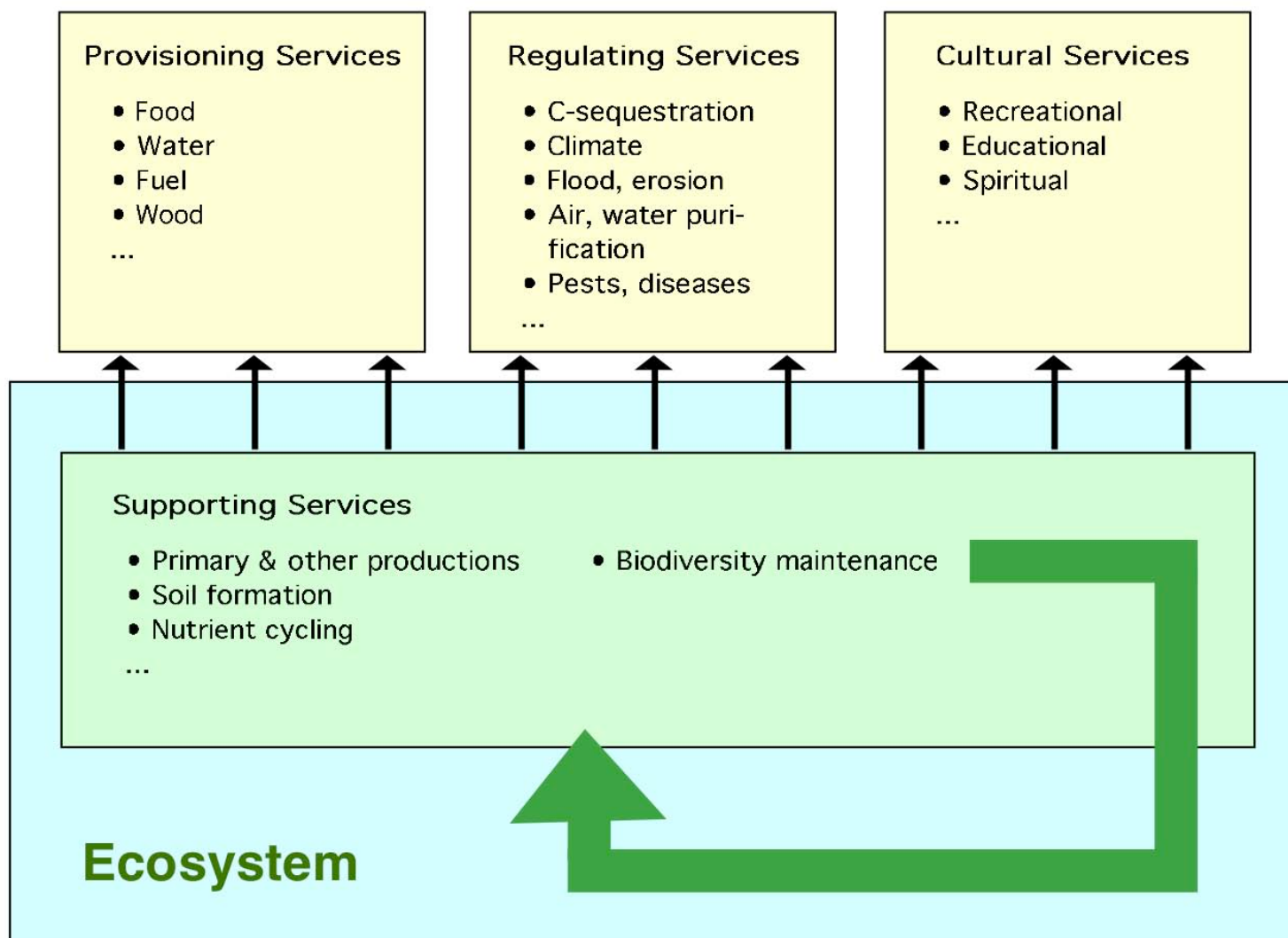
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IPCC Assessment Report 4 WGII, Chapter 4

«Ecosystems, their properties, goods, and services»

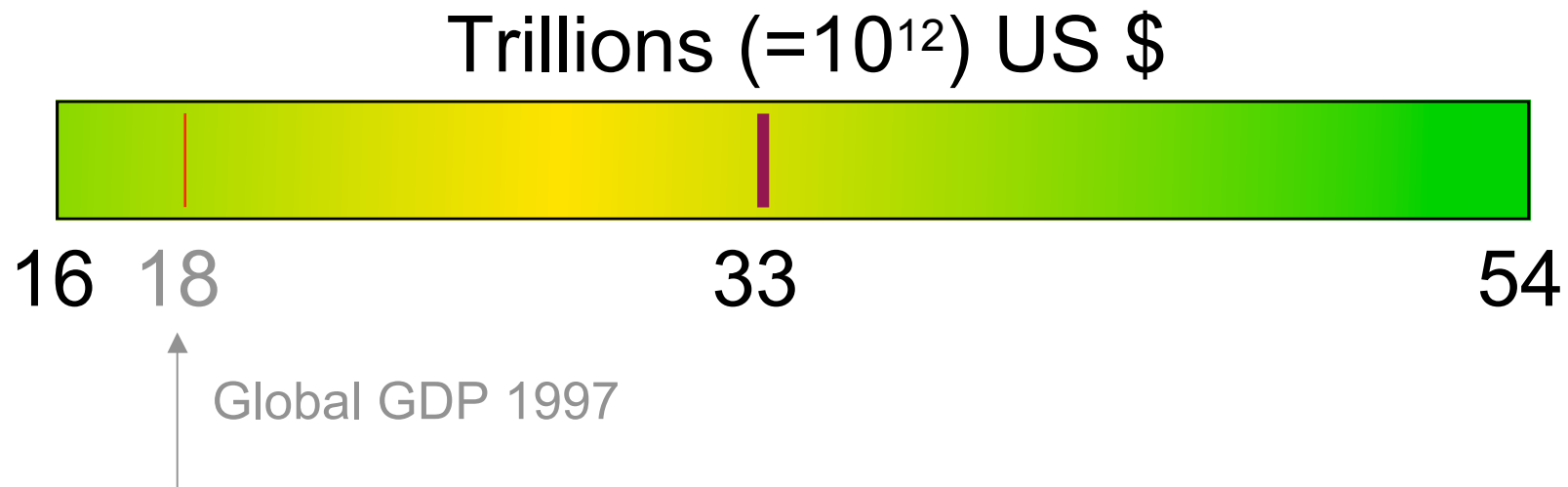
- 2 CLAs: Andreas Fischlin, Guy F. Midgley
- 8 LAs: Jeff Price, Rik Leemans, Brij Gopal, Carol Turley, Mark Rounsevell, Pauline Dube, Juan Tarazona, Andrei Velichko
- 19 CAs with outstanding contributions from Jacqueline de Chazal and Rachel Warren
- 2 REs
- Hundred of expert reviewers, scientists etc.
- >3200 scientific articles reviewed
- 915 cited

Ecosystems Services

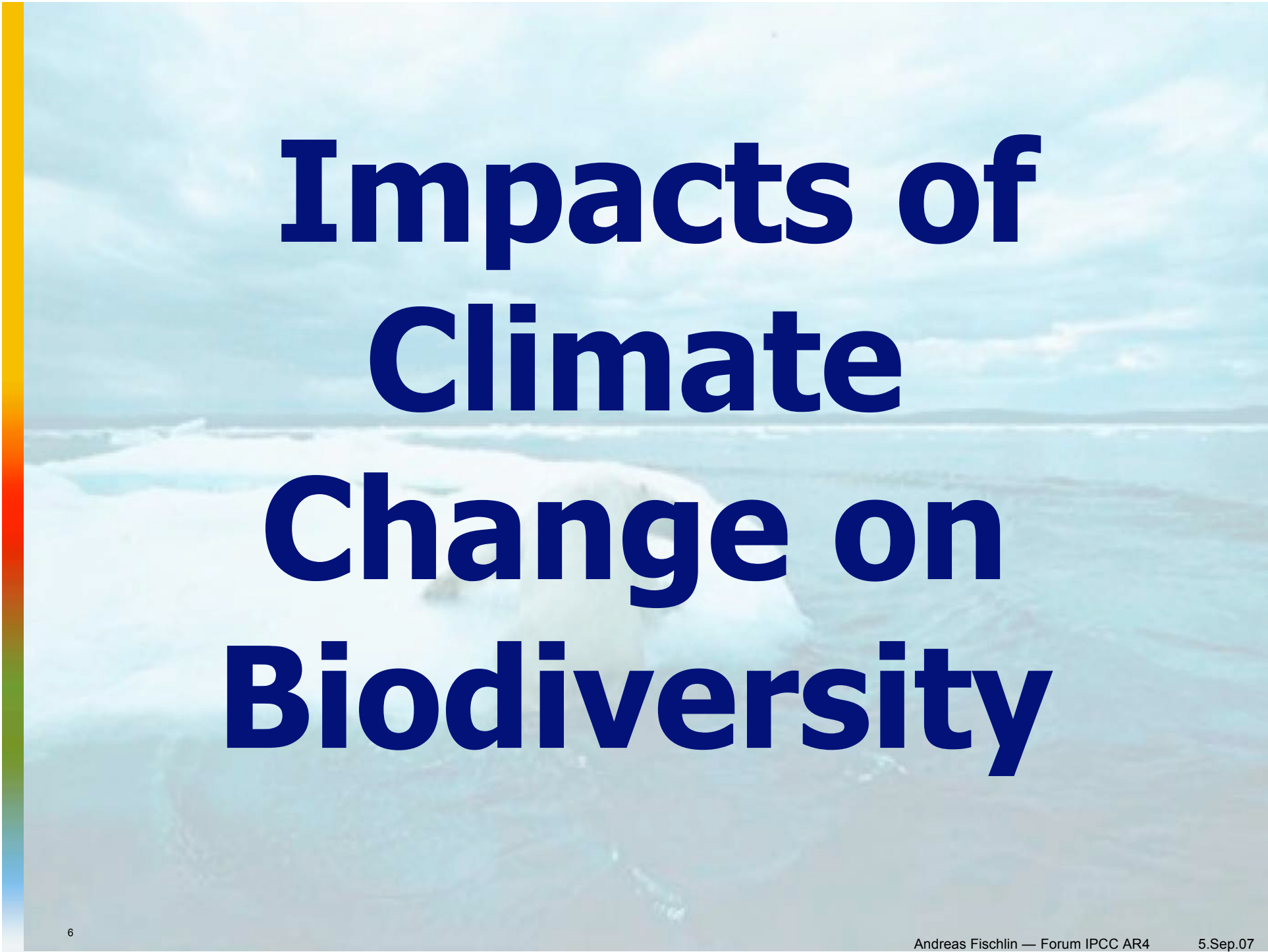


Climate affects ecosystems... and indirectly us!

Economy of ecosystem services:



Costanza *et al.*, 1997. *Nature*, 387: 253-260

A photograph of a polar bear standing on a large, melting ice floe in the middle of the ocean. The sky is overcast and grey. The text "Impacts of Climate Change on Biodiversity" is overlaid in large, bold, blue letters.

Impacts of Climate Change on Biodiversity



Biodiversity?

Biological variability at

- Genetic
- Species
- Ecosystem
level

Biodiversity - Most Vulnerable



Extensively bleached community of corals near Great Keppel Island on the southern Great Barrier Reef in March 2002 at low tide.

Photo Ove Hoegh-Guldberg, Univ. of Queensland

Polar bears have recently been listed as vulnerable due to climate change by IUCN (Wiig, 2005; Schiebe et al., 2006) and also proposed as endangered species on U.S. list of endangered species (Eilperin, 2006; Heilprin, 2006; Roach, 2006)





**20% - 30% of higher
plants and animals at
high risk of extinction**

**if ΔT 1.5°C - 2.5°C
over present**

(medium confidence)

Assessment (19 studies) involved:

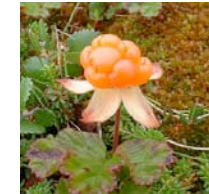
- Higher plant species (vascular plants):

- 40,587 species

- 133,149 (~50%) species (global studies)



Larch



Cloudberry



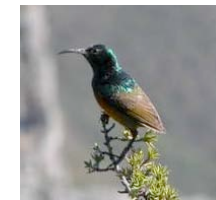
Glacier buttercup

- Higher animal species (vertebrates, butterflies):

- 4,826 species

- 9,645 species (~40% of vertebrates) (global studies)

Sunbird



Arctic fox



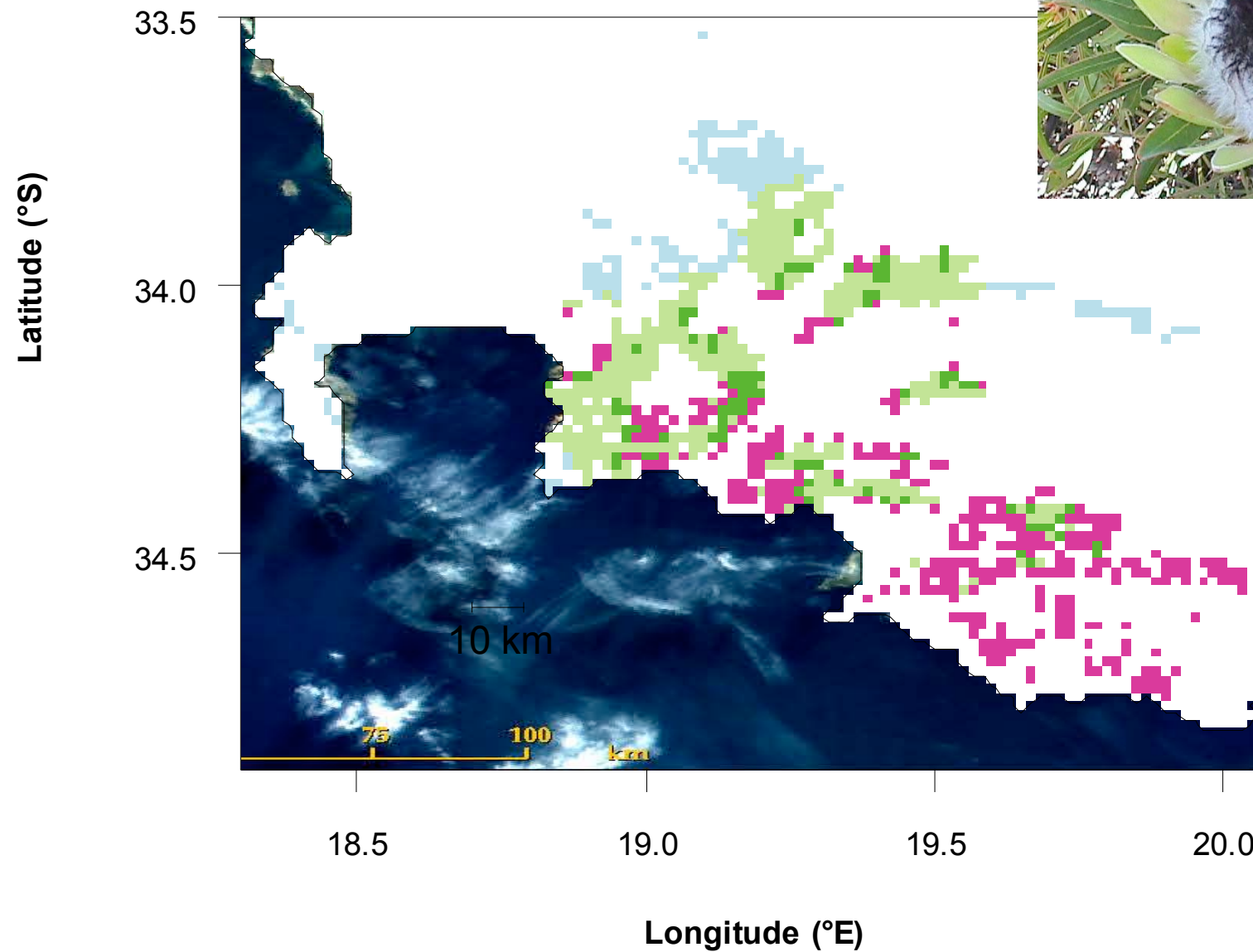
Alpine blue



Two Biodiversity Hotspots

- Fynbos (Cape floristic province): 5'682 endemic vascular plants (300 Proteaceae)
- Succulent Karoo: 1'940 endemic vascular plants (Biome)
- 277 African mammals (at continental scale)

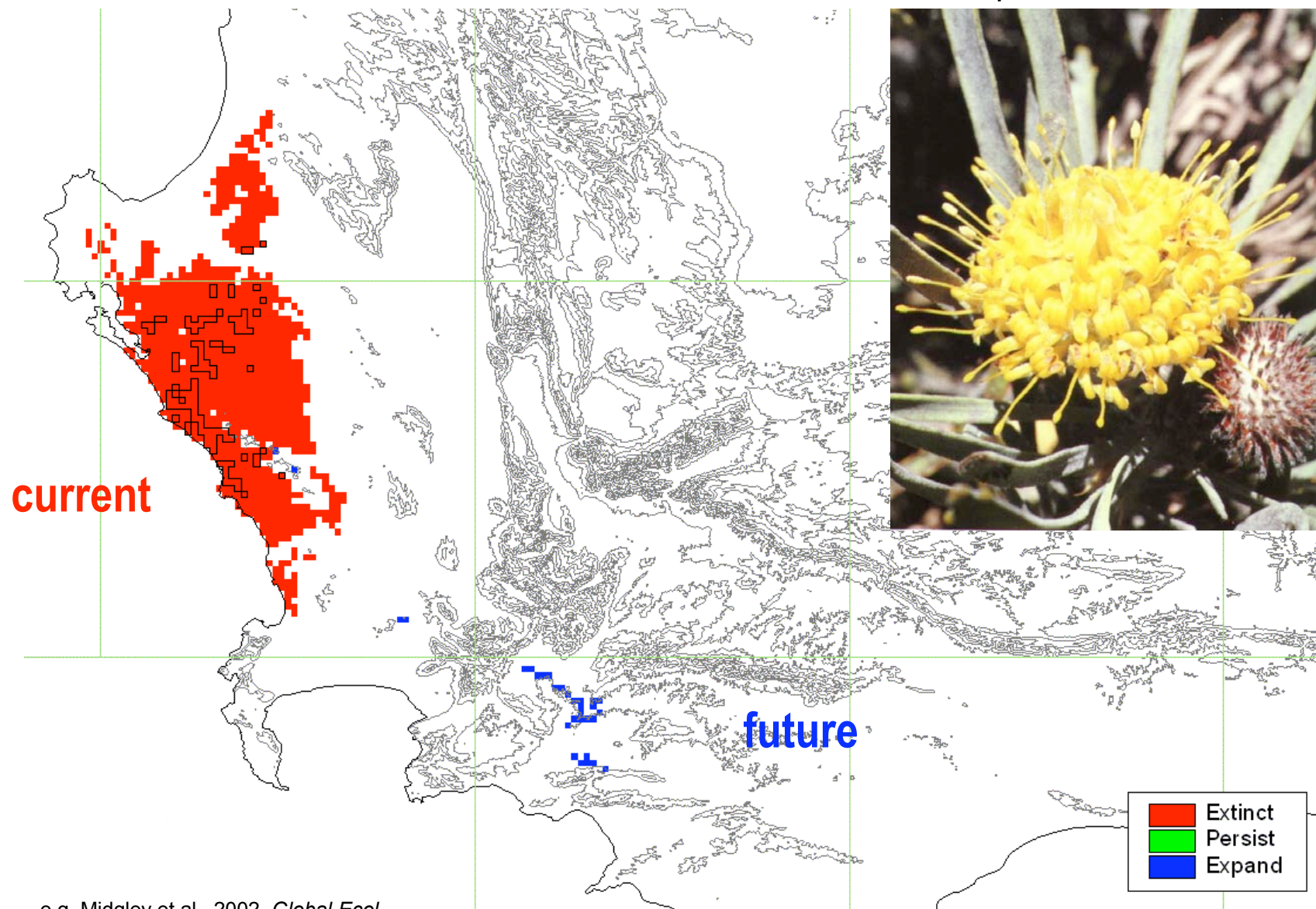
E.g. “Adapting” species



*Long-leaf
sugarbush
Protea
longifolia*

E.g. “Loser” species

Sunshine conebush
Leucospermum tomentosum



e.g. Midgley et al., 2002. *Global Ecol. Biogeogr.*, 11(6): 445-451.

Range response types



6 (3%)
winners

21 (9%)
unchanging

36 (15%)
adapting



178 (73%)
losers



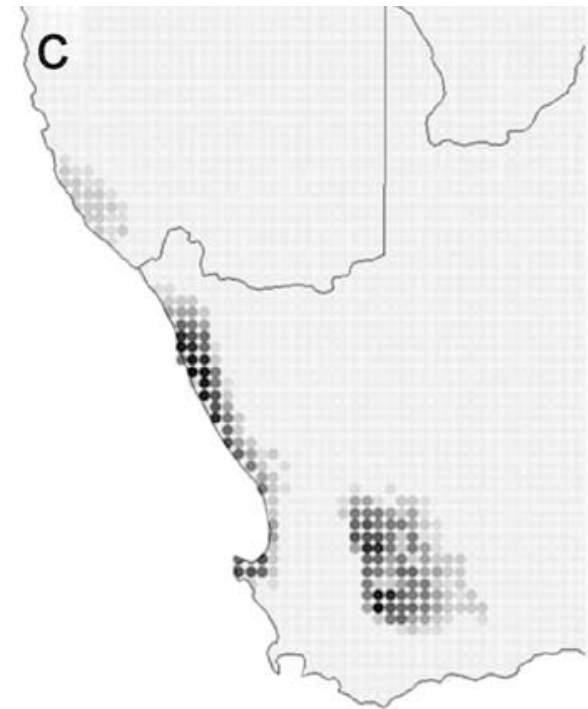
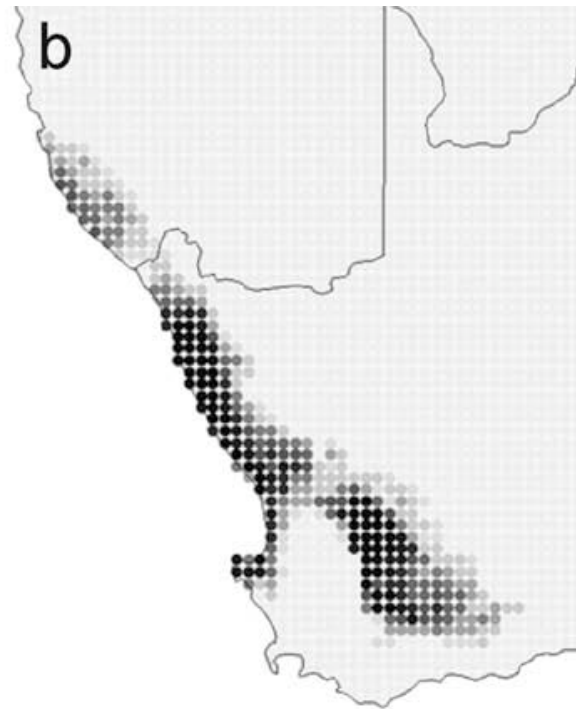
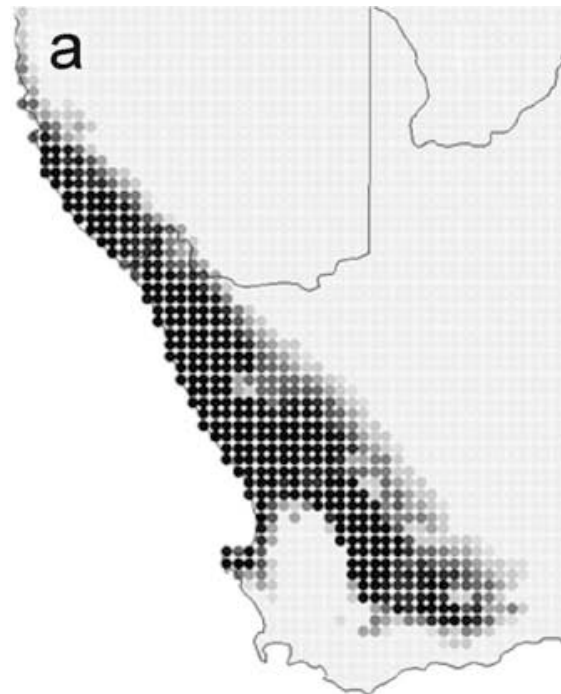
Entire ecosystem

Example Succulent Karoo:

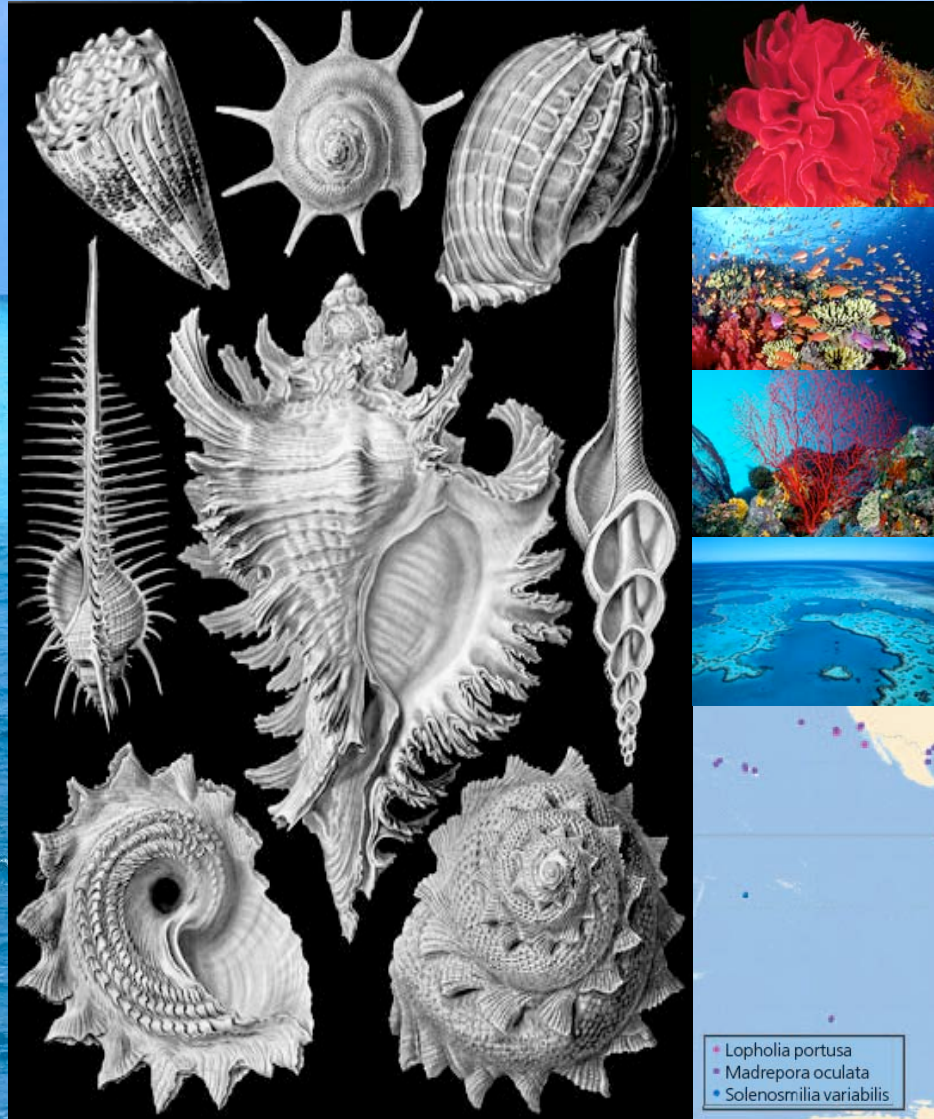
current

~2050

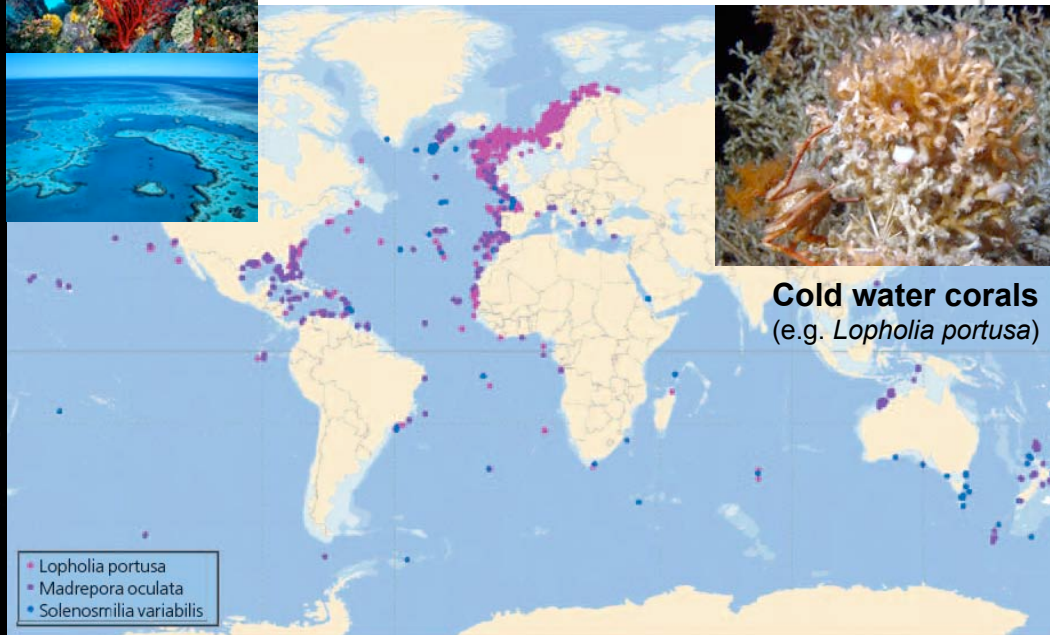
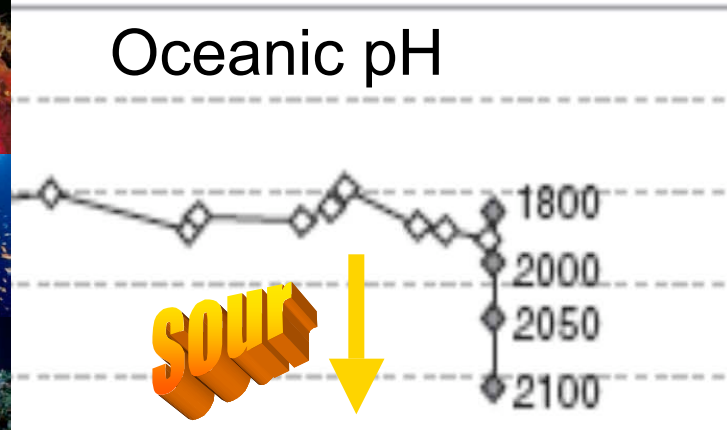
~2080



Ocean acidification

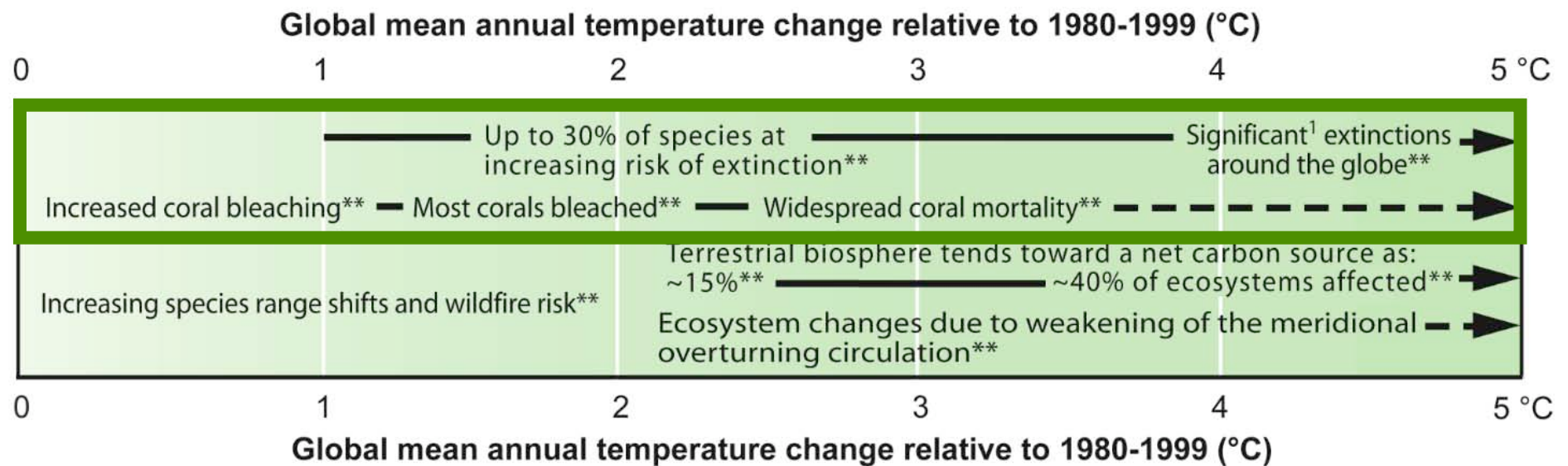


Oceanic pH



Summary

Impacts on Biodiversity



¹ Significant is defined here as more than 40%.

SPM AR4 IPCC Working Group II

A polar bear is walking on a large, melting ice floe in the ocean. The sky is overcast with grey clouds. The text "Emissions from Terrestrial Ecosystems" is overlaid in large, bold, blue letters.

Emissions from Terrestrial Ecosystems

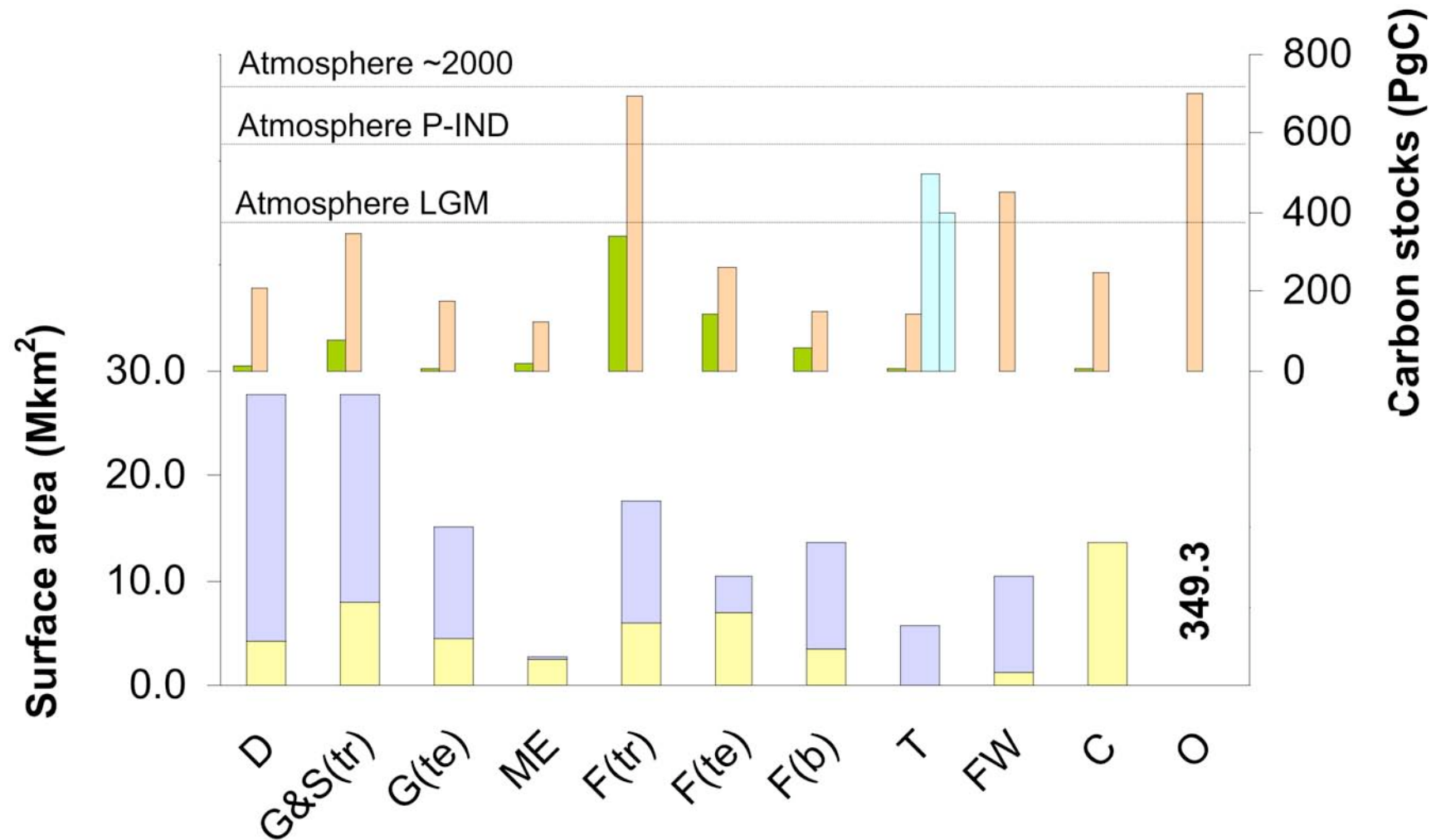


Terrestrial ecosystems become net source

Over the course of this century, net carbon uptake by terrestrial ecosystems is likely to peak before mid-century and then weaken or even reverse, thus amplifying climate change.

(high confidence)

More Carbon Stored in Ecosystems



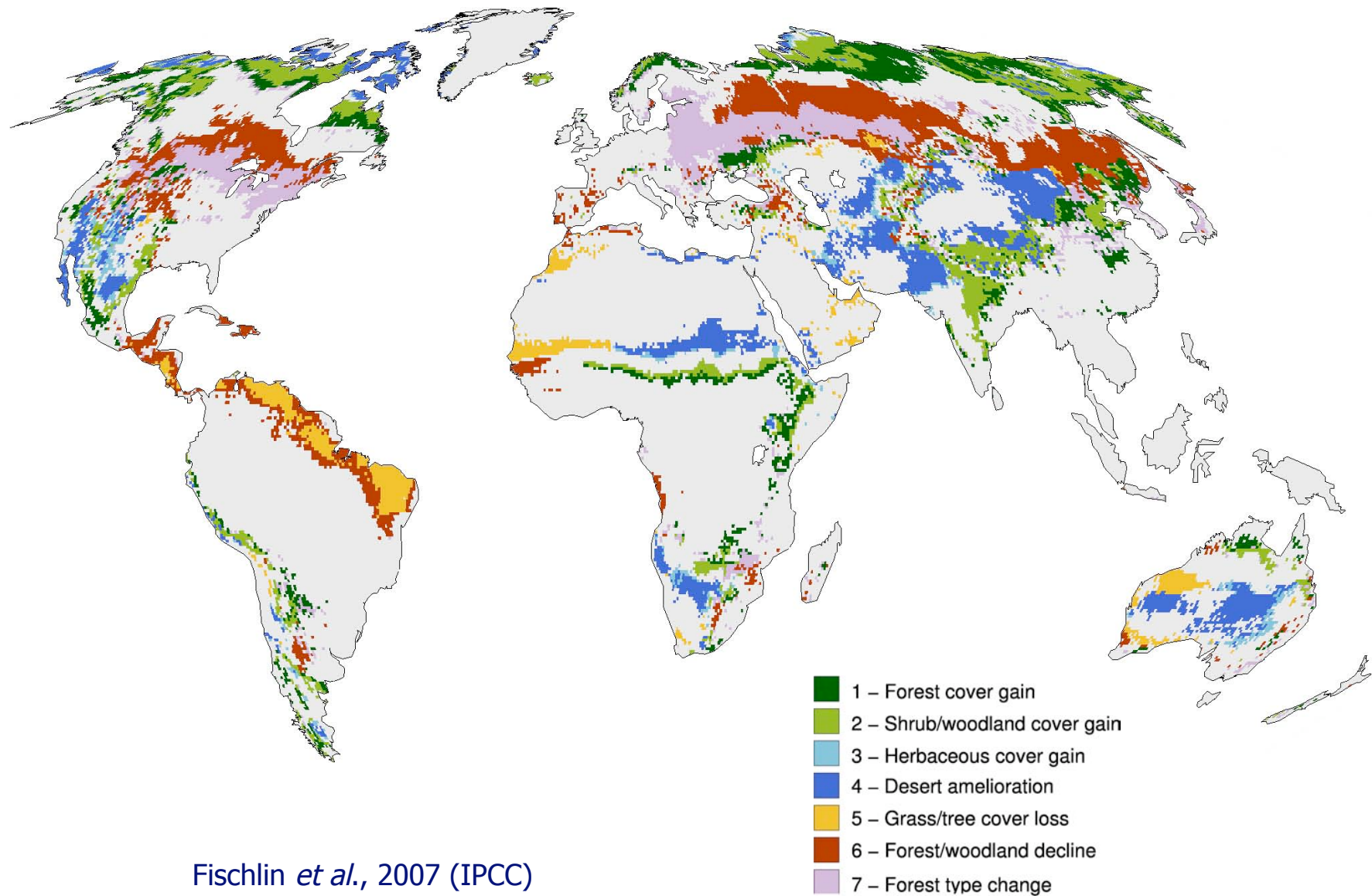
More Carbon Stored in Ecosystems



Effects from Fire included



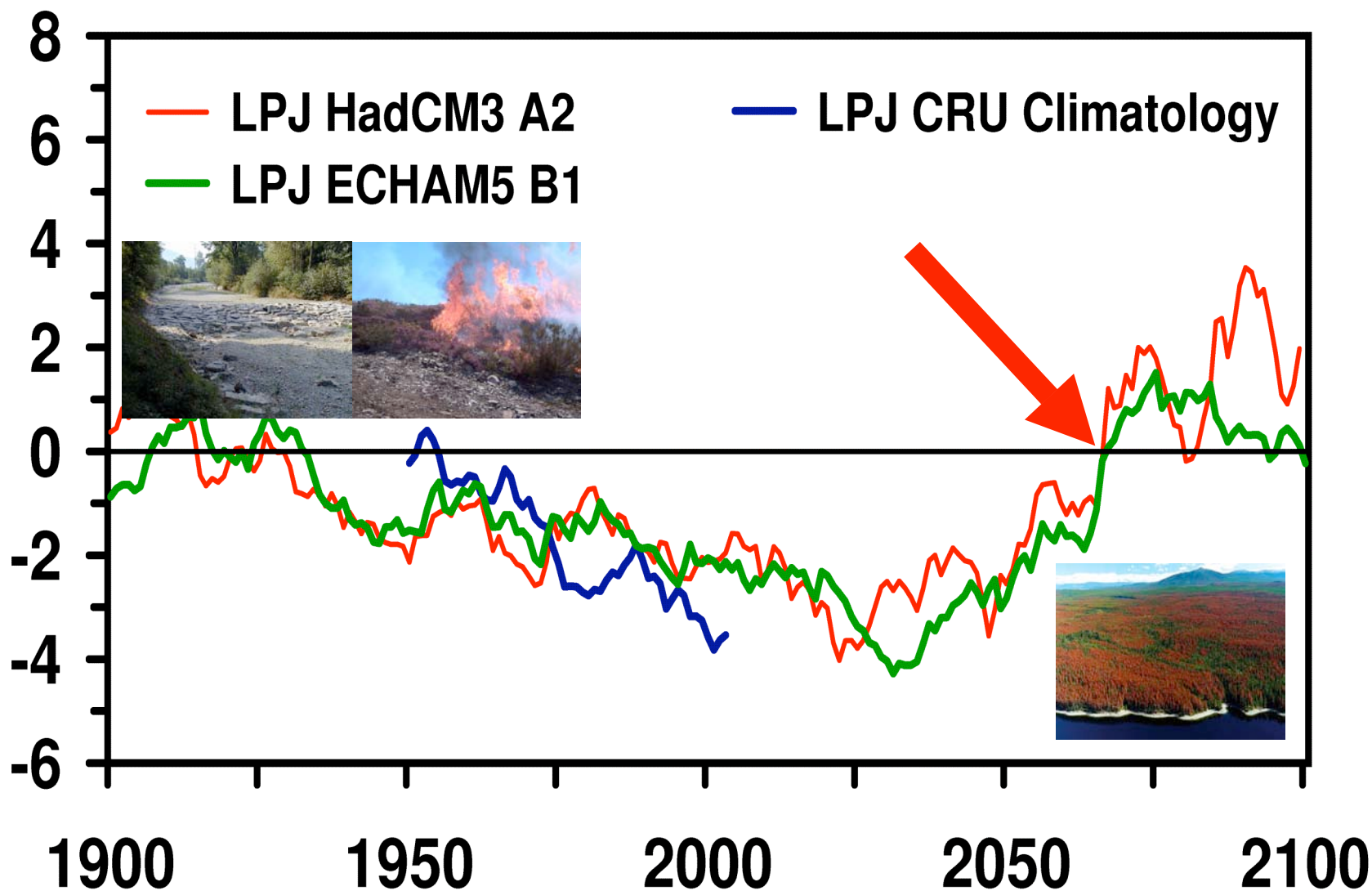
Some DGVM Results - LPJ A2 HadCM3



Fischlin *et al.*, 2007 (IPCC)

Net Carbon Exchange (PgC/year)

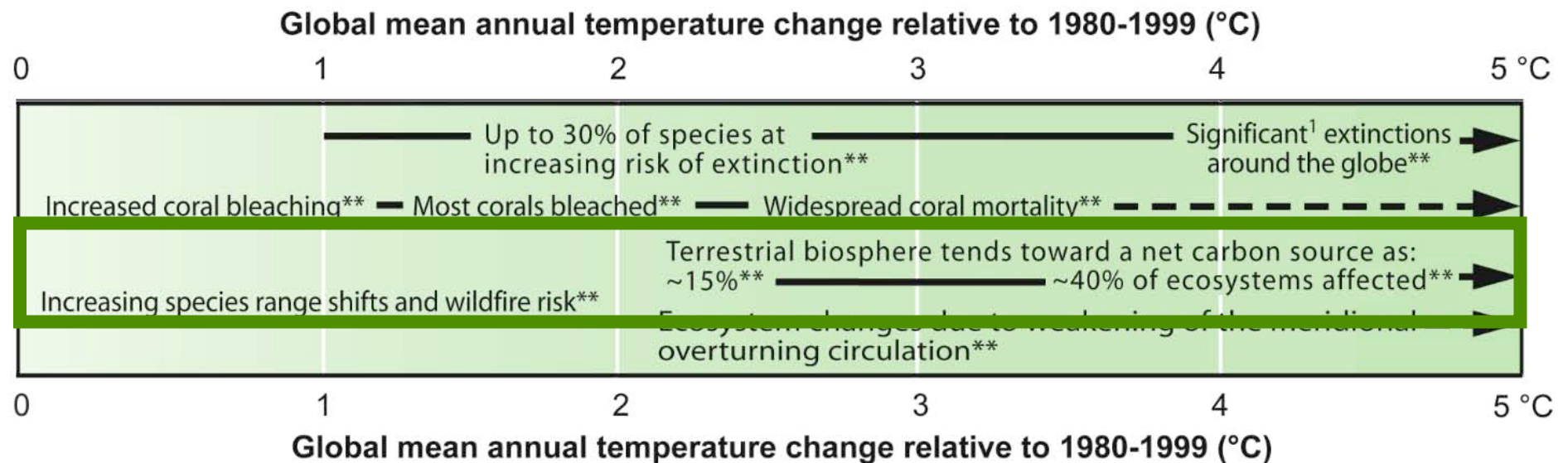
From DGVM Results - Sink Weakens



Fischlin *et al.*, 2007. Ecosystems. In IPCC AR4 WII

Summary

Emissions from ecosystems



¹ Significant is defined here as more than 40%.

SPM AR4 IPCC Working Group II

A polar bear is seen from behind, standing on a large, white ice floe that is melting in a dark blue sea. The sky is a pale blue with soft, white clouds. The overall scene conveys a sense of environmental change and resilience.

Resilience Exceeded

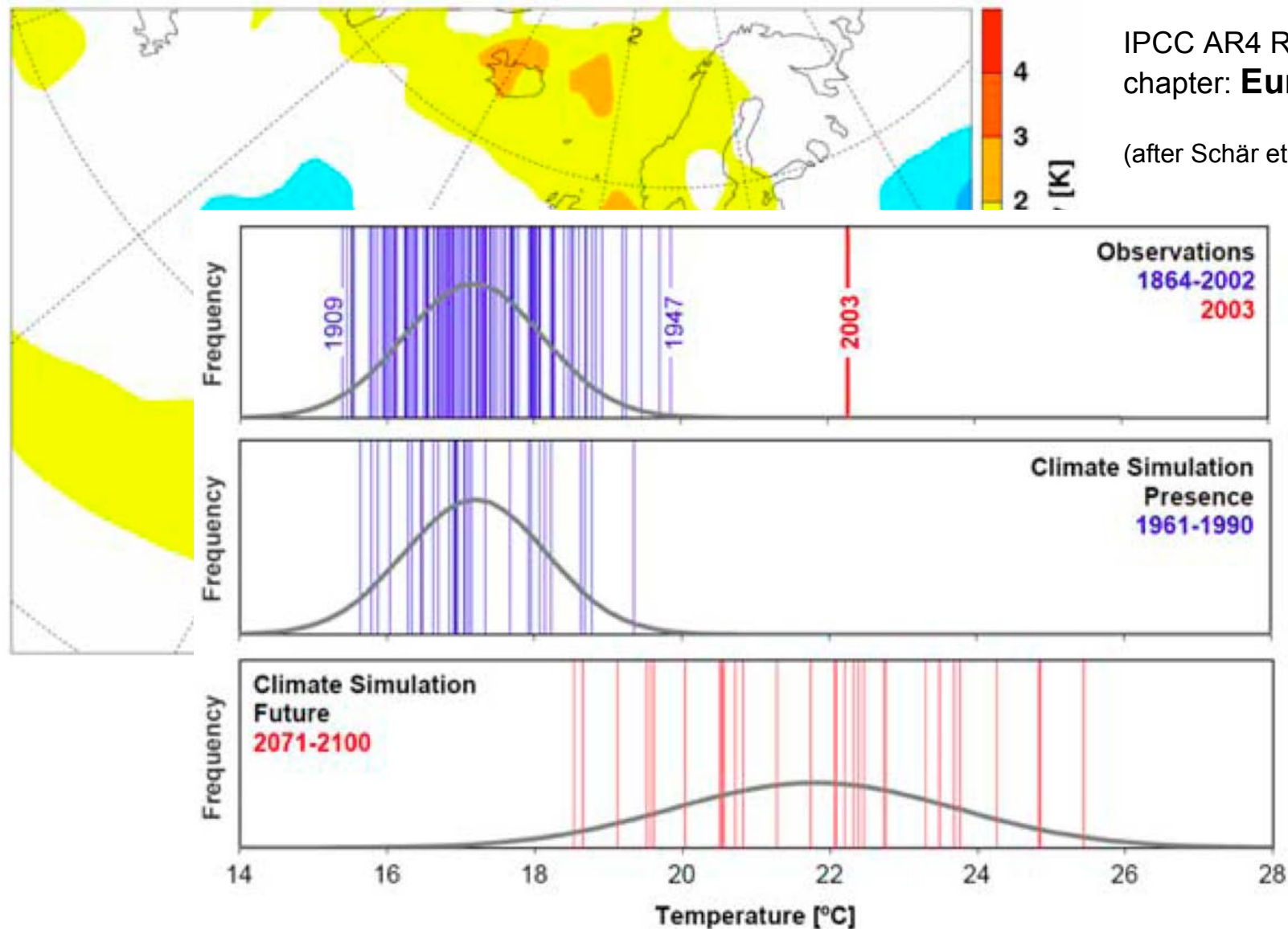
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Ecosystems in this century

The resilience of many ecosystems is likely to be exceeded this century by an unprecedented combination of climate change, associated disturbances (e.g., flooding, drought, wildfire, insects, ocean acidification), and other global change drivers (e.g., land use change, pollution, overexploitation of resources).

(high confidence)

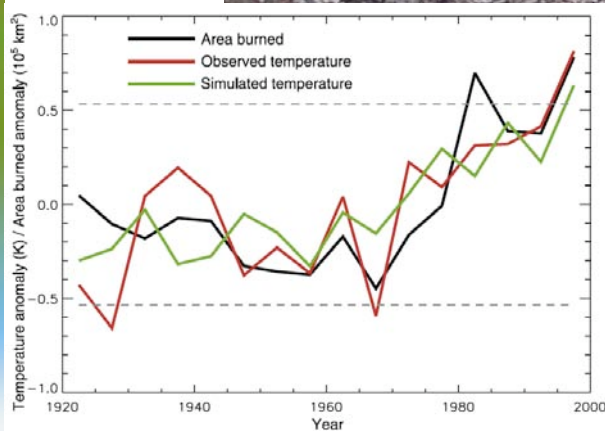
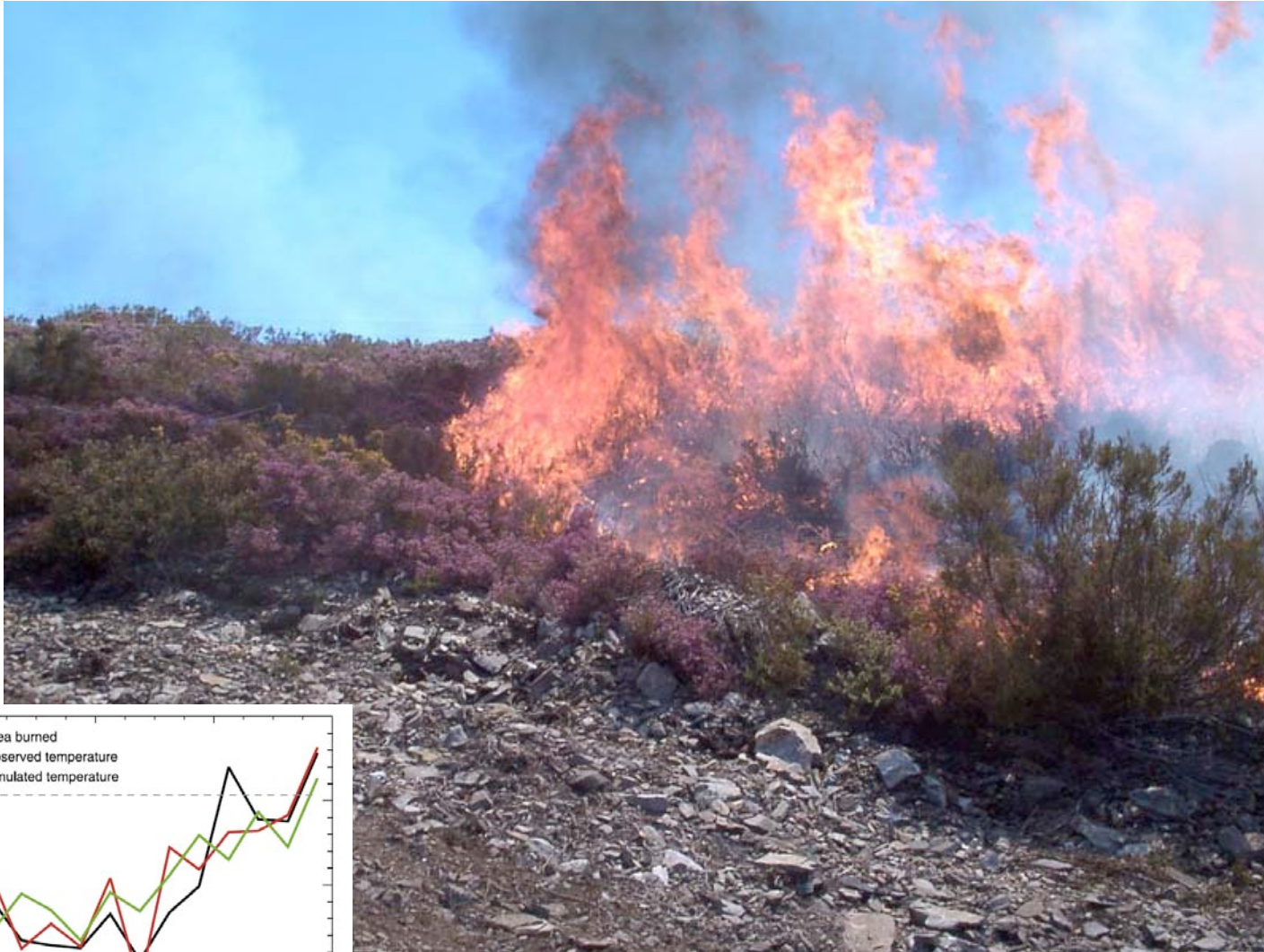
Summer 2003 - Model for end 21st Ct.



IPCC AR4 Regional
chapter: **Europe**

(after Schär et al., 2004)

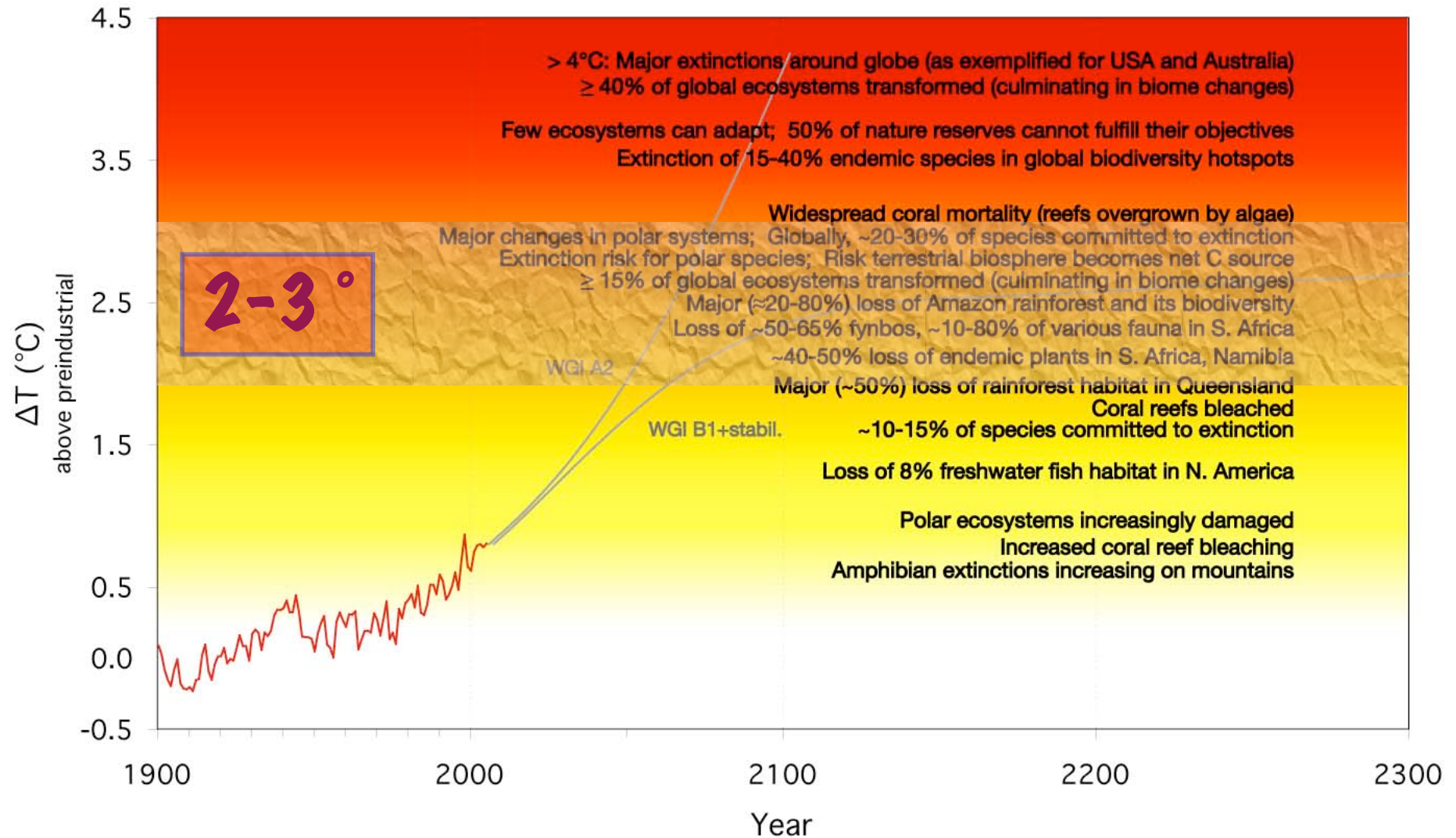
Changes in fire regime



Changes in insect outbreaks



Summary - Ecosystem impacts



most corals bleached

+2°

+1.7°



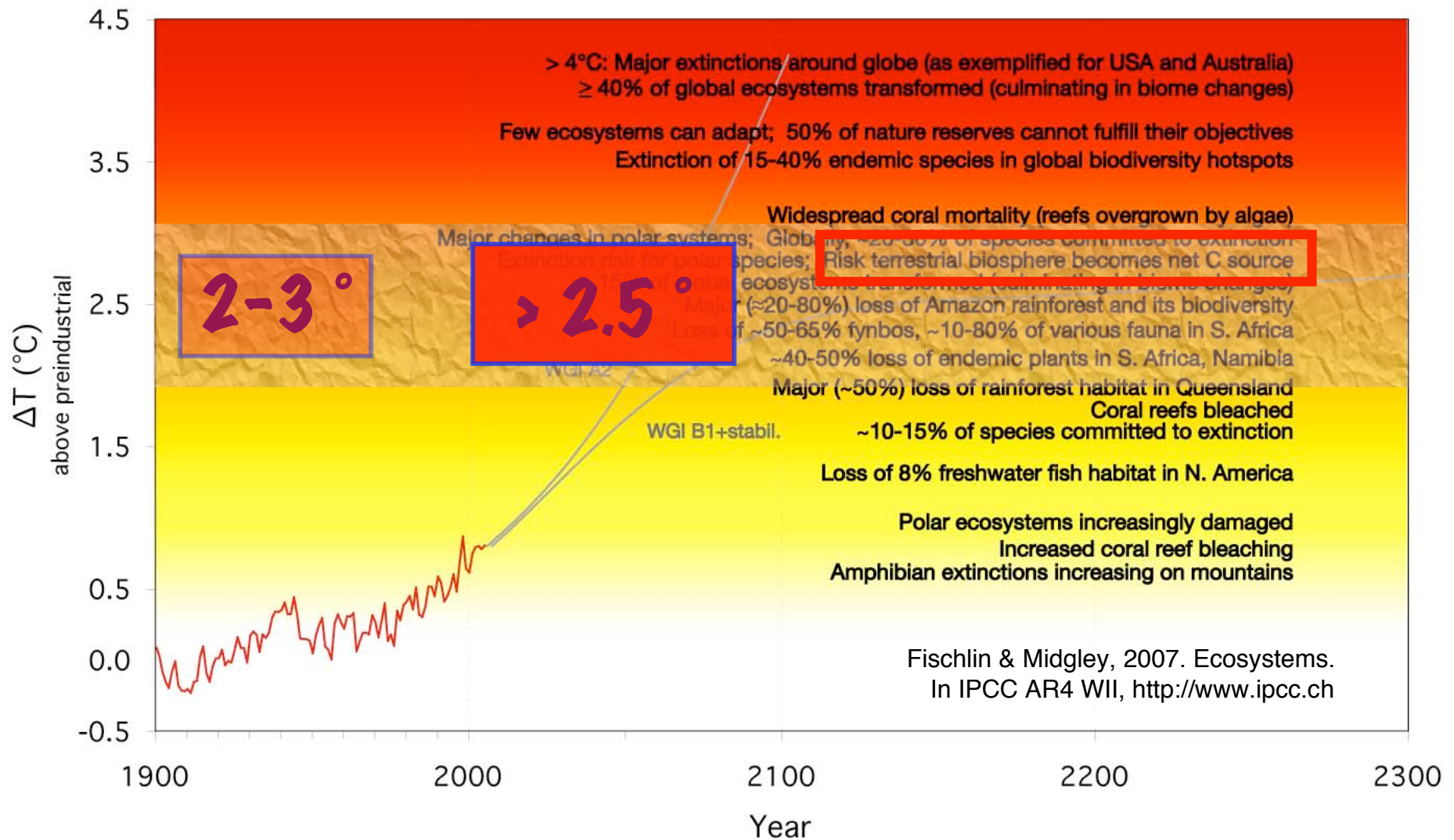
Loss in South Africa: ~10-80% fauna,
~40-50% plants (~50-65% Fynbos)

+2.1°

+2°



Terrestrial biosphere's sink weakens





+2.8°

+3°

Extinction risk for polar species
Major changes in polar systems



$+3.5^{\circ}$



$+3^{\circ}$



In biodiversity hotspots (e.g. coral reefs, tropical rain forests) 15-40% endemics at risk; half of nature reserves fail



A polar bear is standing on a small, white ice floe in the middle of a dark blue sea. The bear is facing right, with its head slightly turned. The sky is filled with heavy, grey clouds. The overall scene conveys a sense of isolation and the impact of climate change on Arctic wildlife.

Thanks for your attention!

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