Risks For Ecosystems

Key Findings from the Fourth Assessment Report of IPCC

Andreas Fischlin & Guy Midgley

Coordinating Lead Authors chapter «Ecosystems, their Properties, Goods, and Services» from the Assessment Report Four of the IPCC

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Contents

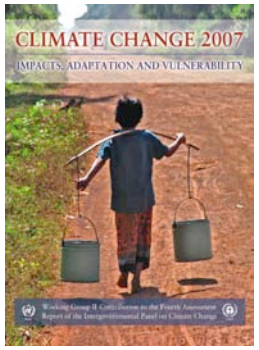
- Background
- Projected, future impacts
- Ecosystems and tipping points
- Conclusions









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, Ca 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

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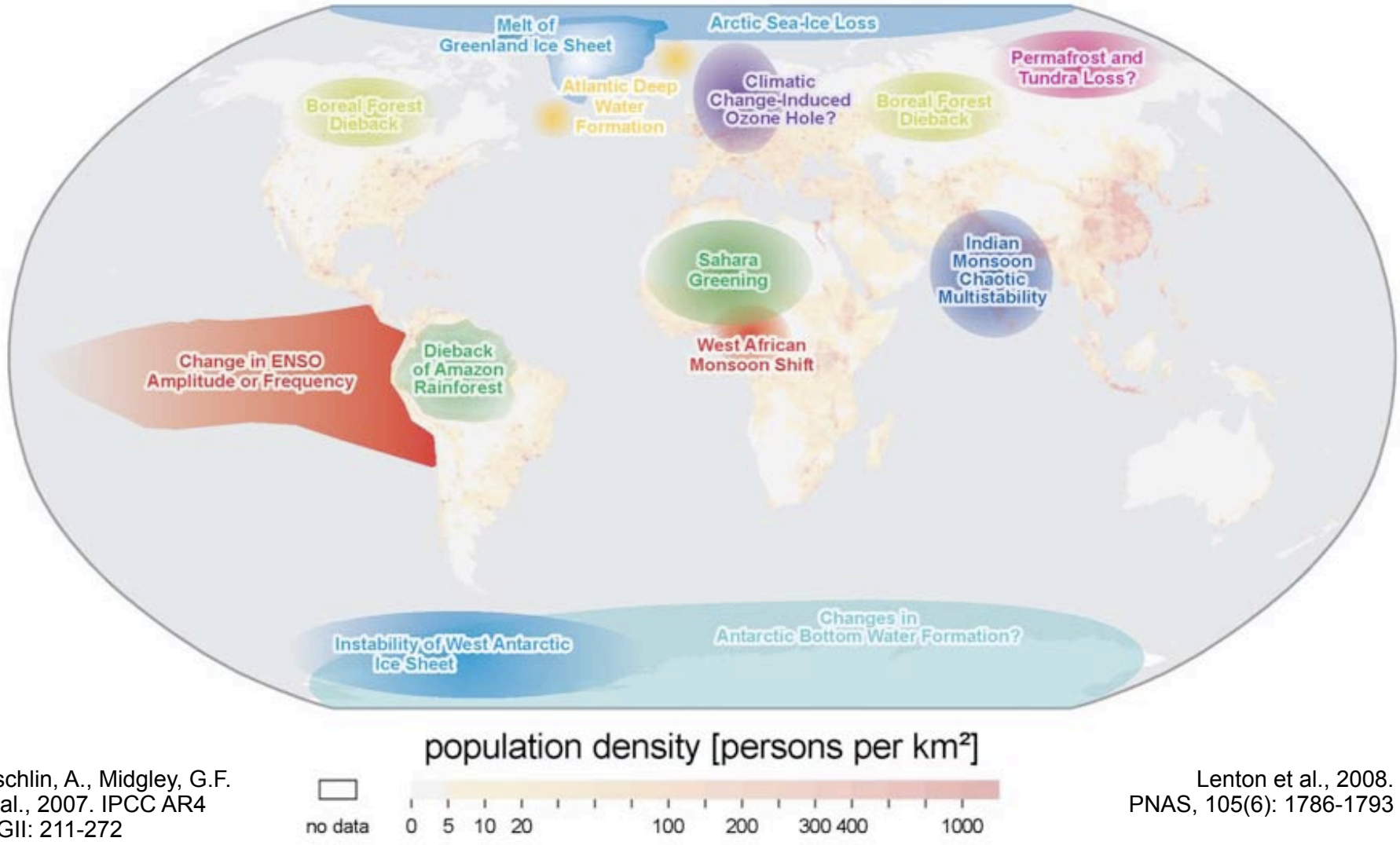
Future Resilience of Ecosystems

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)

IPCC, 2007. SPM WGII, p.11

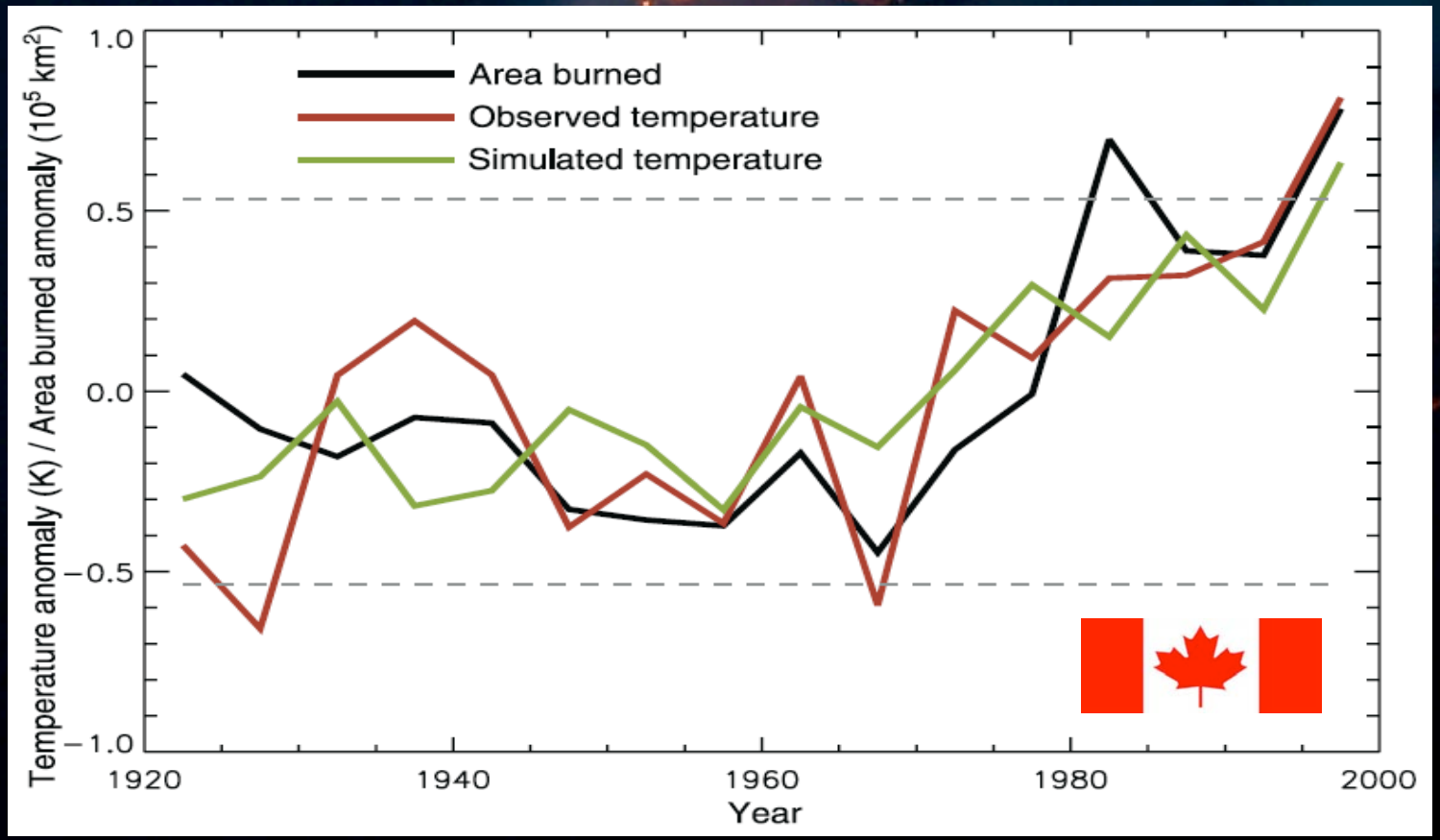
Fischlin et al. 2007 and Lenton et al. 2008



Fischlin, A., Midgley, G.F. et al., 2007. IPCC AR4 WGII: 211-272

Lenton et al., 2008. PNAS, 105(6): 1786-1793

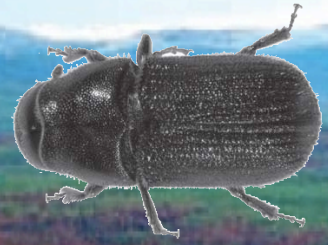
Increasing Trends in Fire Frequencies

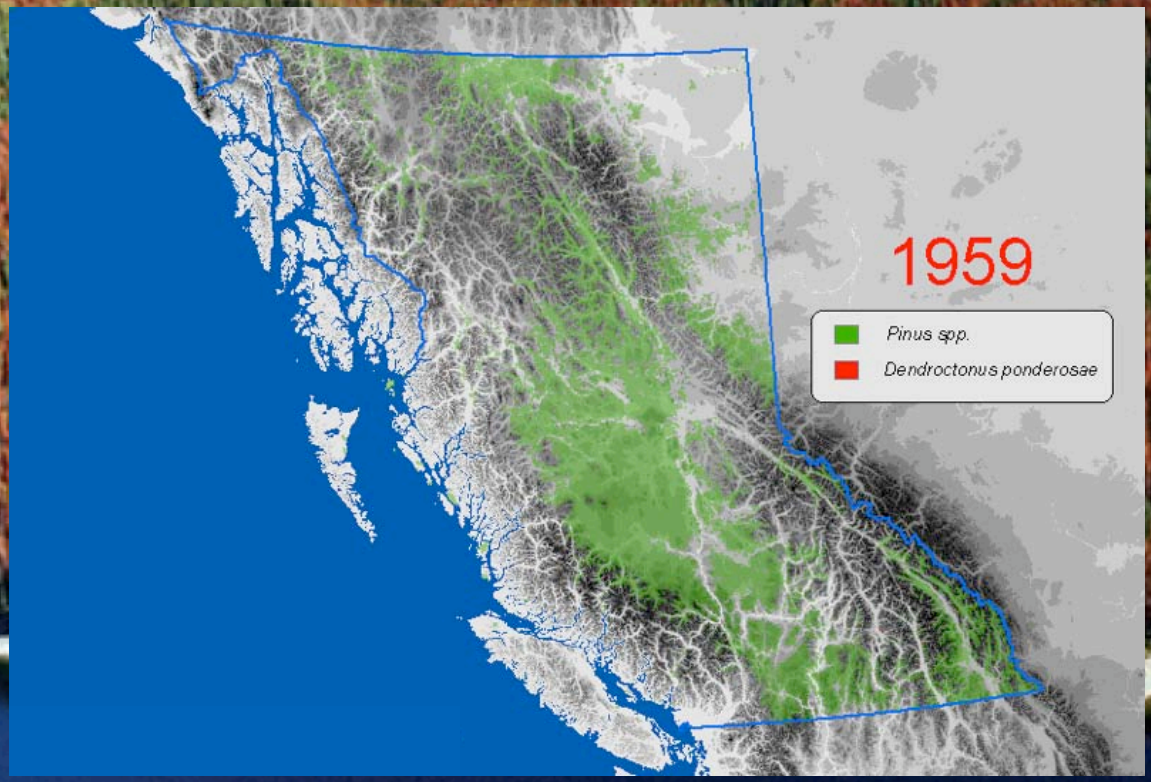


Andreas Fischlin & Guy Midgley — Coordinating Lead Authors IPCC AR4 — ETH Zurich, Switzerland & Kirstenbosch Research Center, South Africa

Forest pests - **Mountain Pine Beetle**

(***Dendroctonus ponderosae, Col., Scolytidae***)

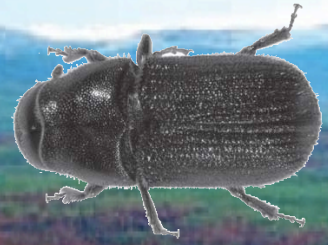


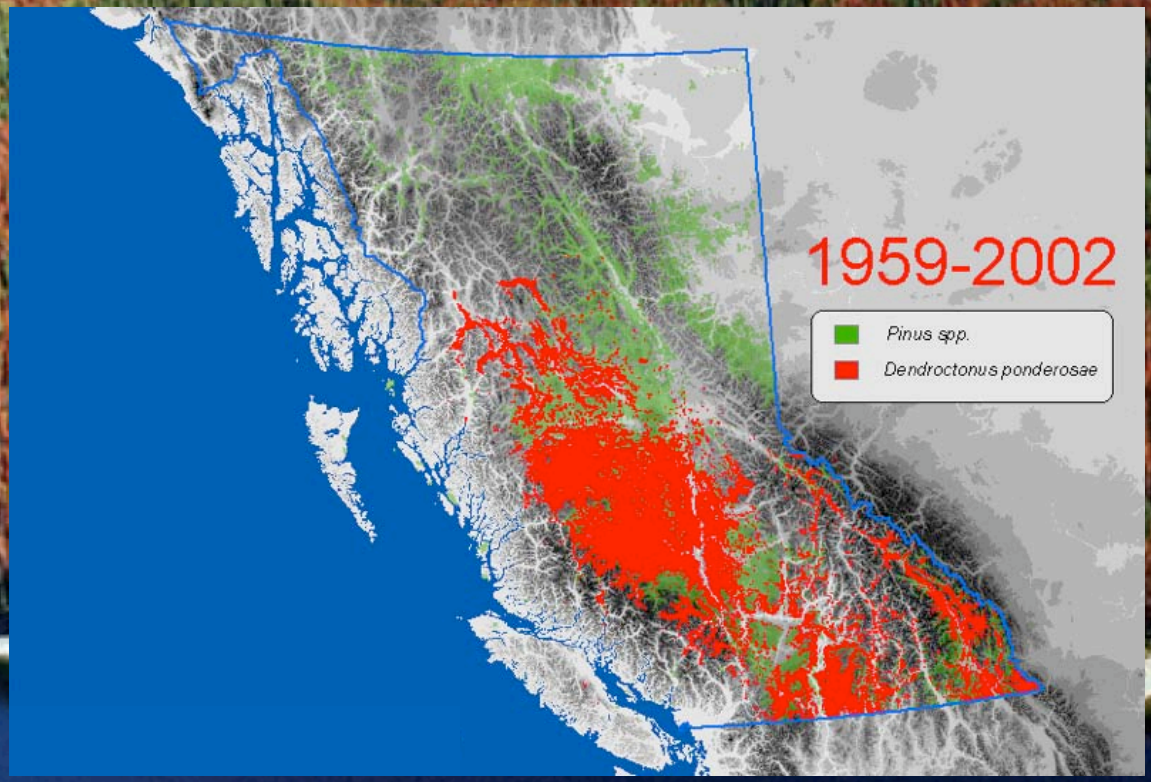


Section 4.4.5
(Fischlin *et al.*,
2007. IPCC WGII)

Forest pests - **Mountain Pine Beetle**

(***Dendroctonus ponderosae, Col., Scolytidae***)

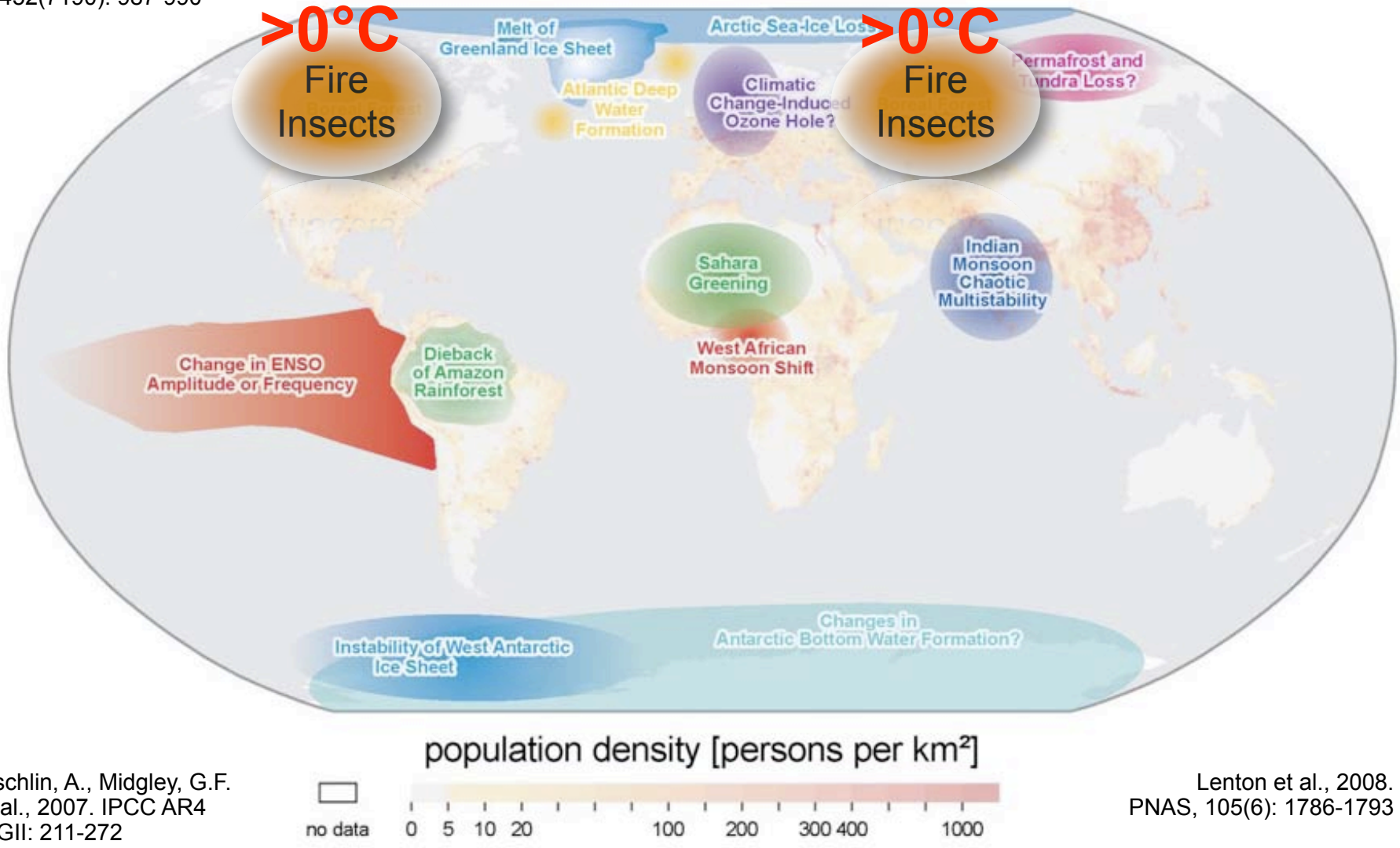




Section 4.4.5
(Fischlin *et al.*,
2007. IPCC WGII)

Fischlin et al. 2007 and Lenton et al. 2008

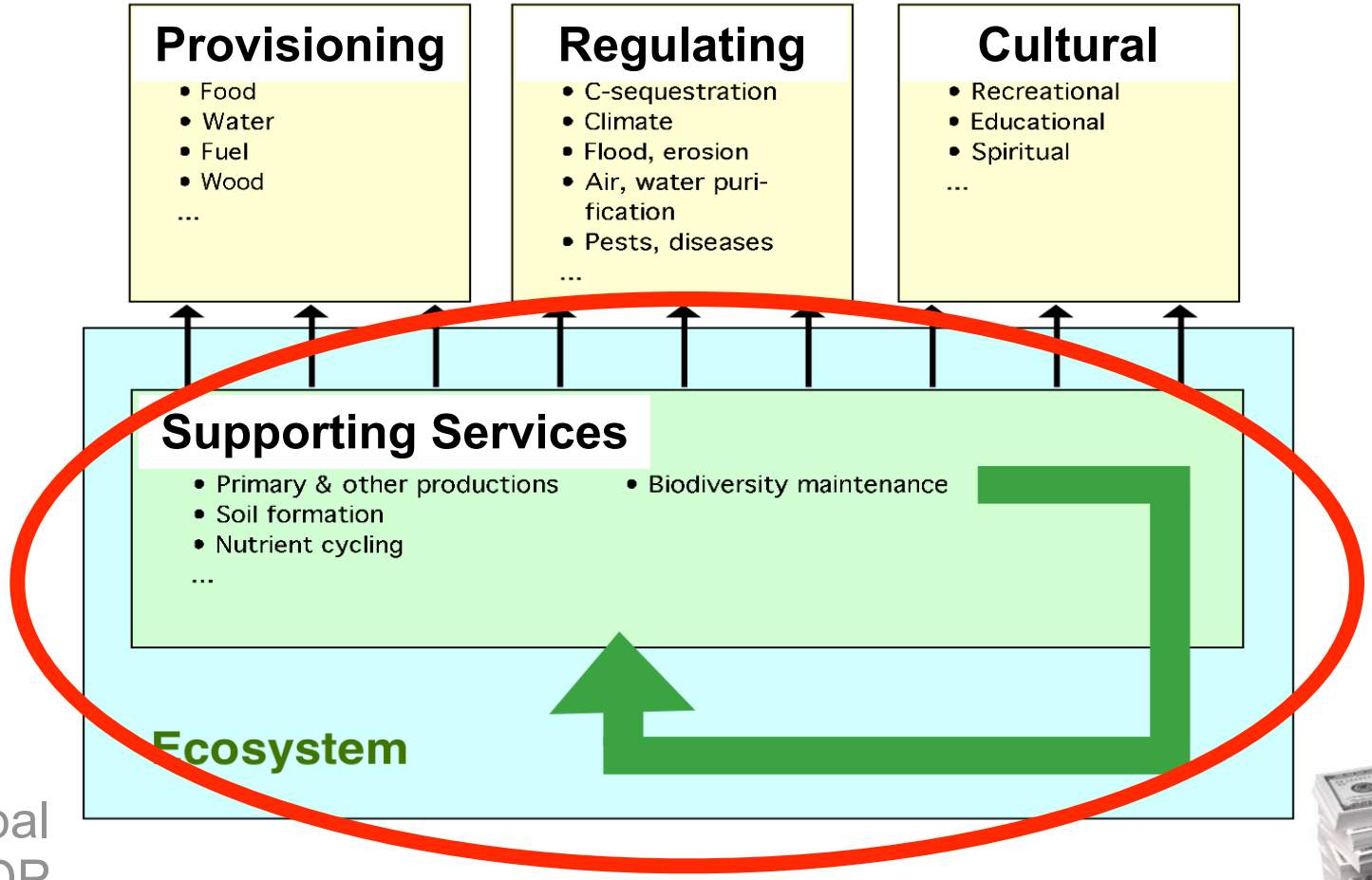
Kurz et al.., 2008. Nature, 452(7190): 987-990



Fischlin, A., Midgley, G.F. et al., 2007. IPCC AR4 WGII: 211-272

Lenton et al., 2008. PNAS, 105(6): 1786-1793

Ecosystems Services



Global GDP 1997 ↓18

Trillions (=10^{12} =Tera) US $

16	33	54

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

Impacts on Biodiversity

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

if ΔT 1.5°C - 2.5°C over present

(medium confidence)

Burning Ember Diagram: Compiles Impacts

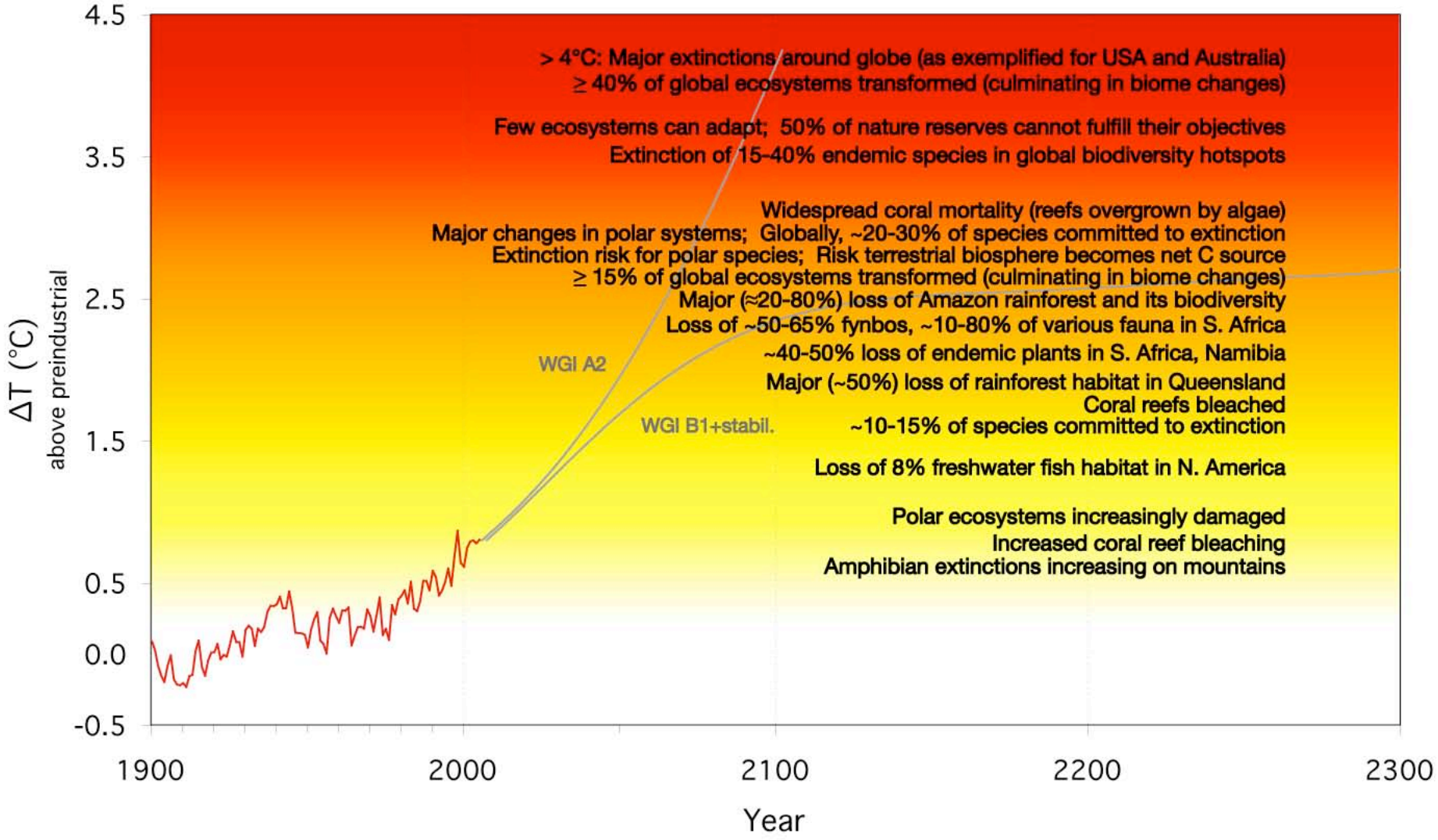
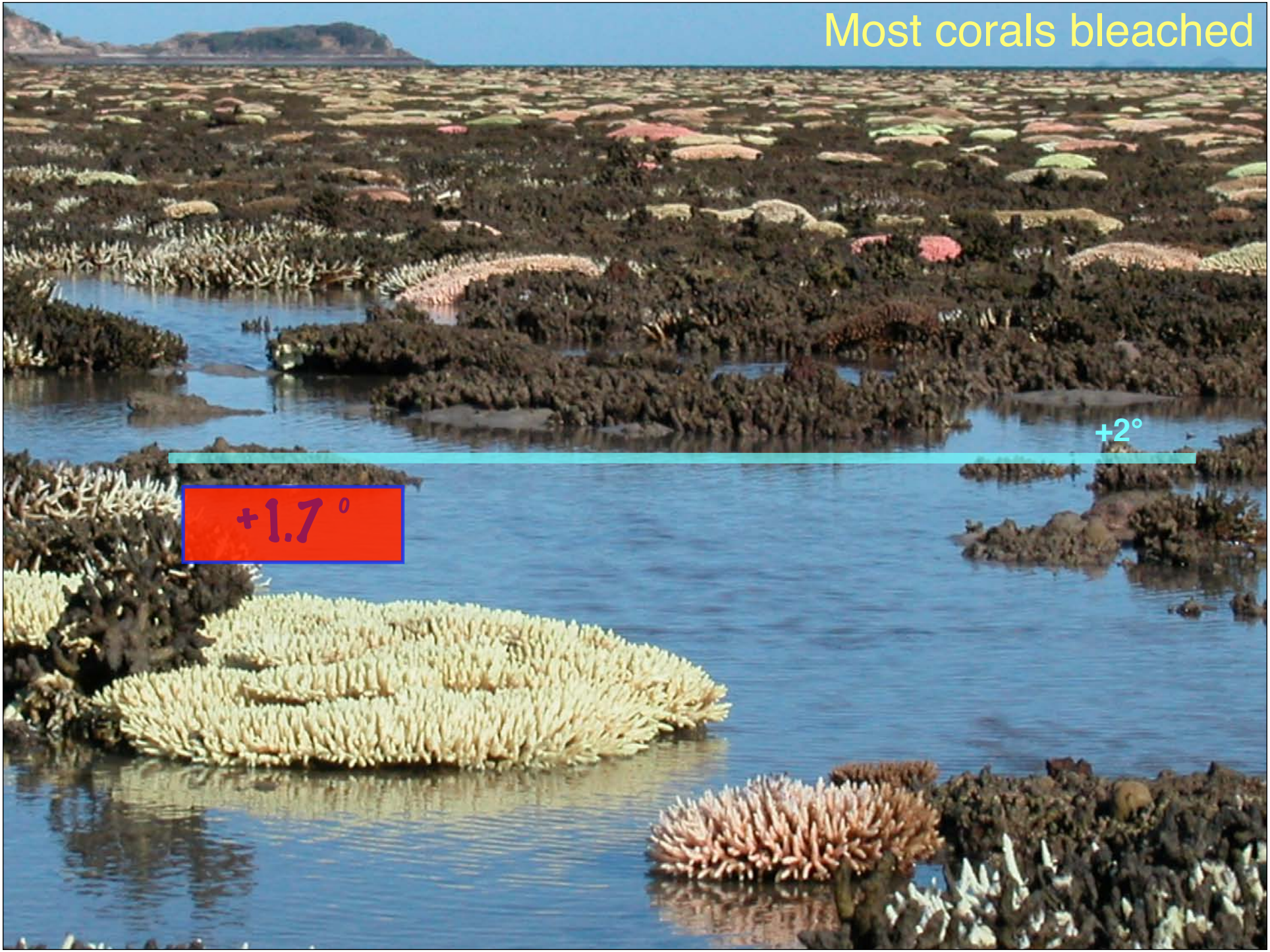
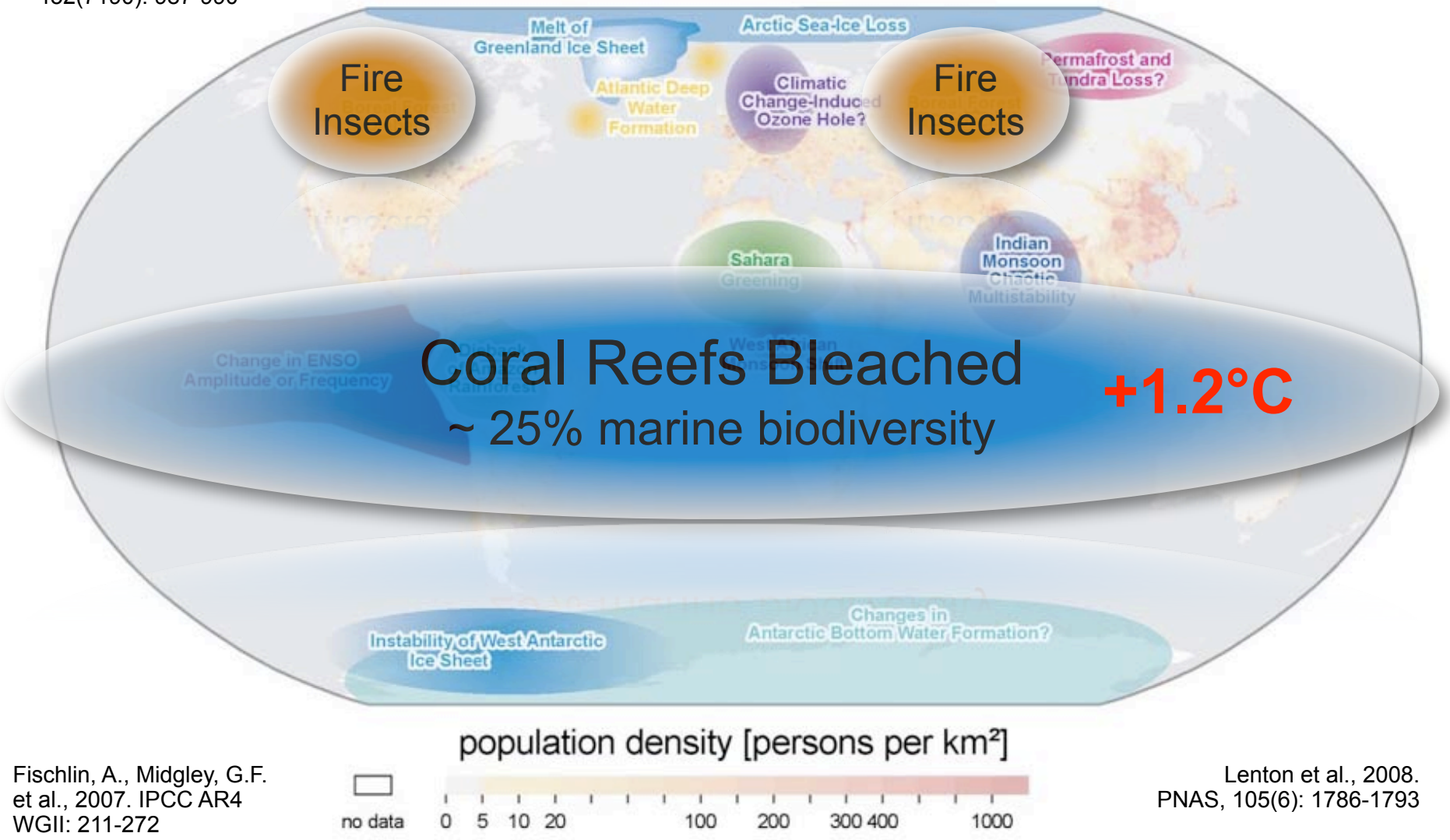


Figure TS.6:Compendium of projected risks due to critical climate change impacts on ecosystems for different levels of global mean annual temperature rise IPCC, 2007. Technical Summary WGII


Most corals bleached
+2°
+1.7°

Fischlin et al. 2007 and Lenton et al. 2008

Kurz et al.., 2008. Nature, 452(7190): 987-990



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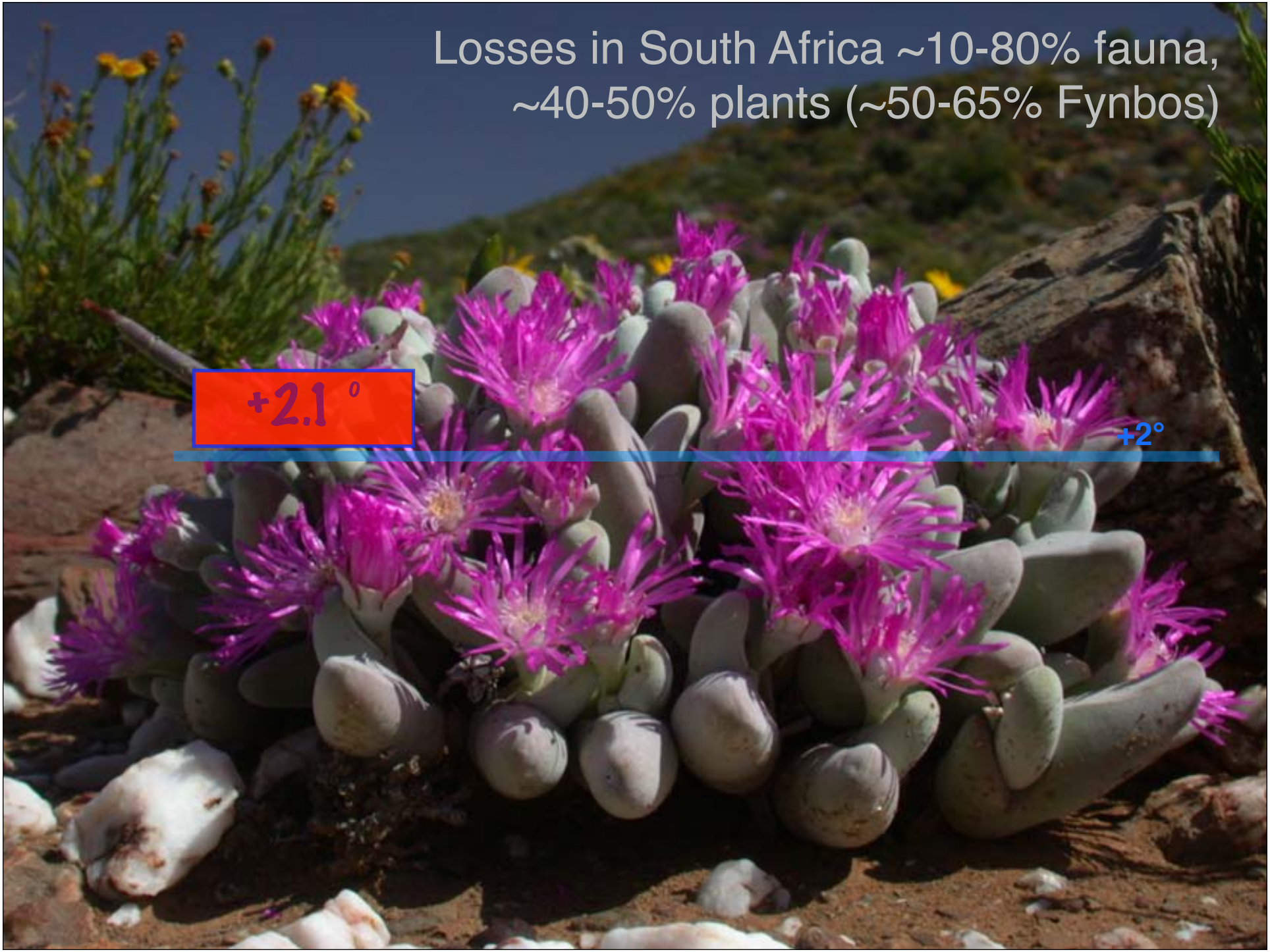
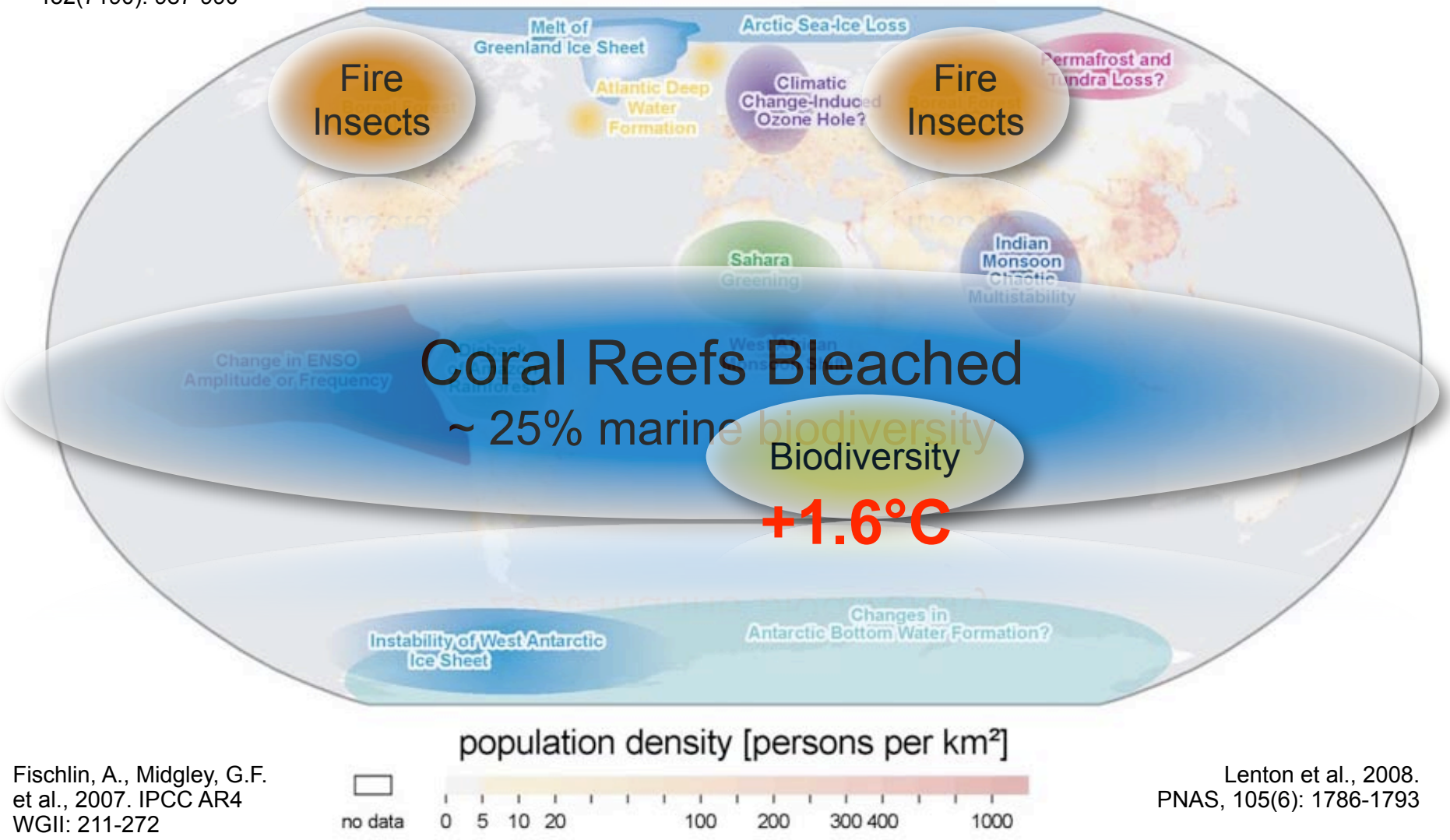

Losses in South Africa ~10-80% fauna,
~40-50% plants (~50-65% Fynbos)
+2.1 °
+2°

Fischlin et al. 2007 and Lenton et al. 2008

Kurz et al.., 2008. Nature, 452(7190): 987-990



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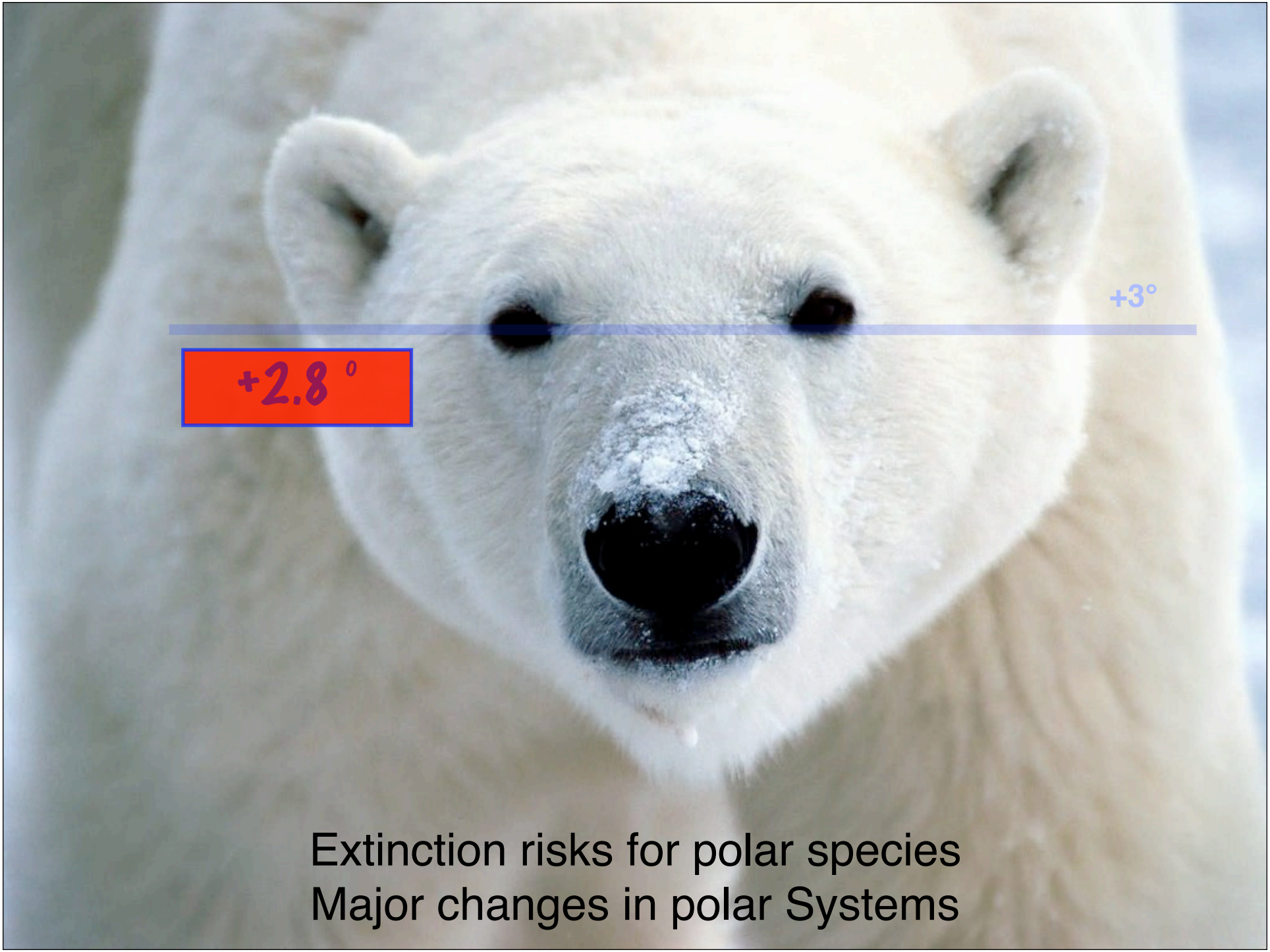
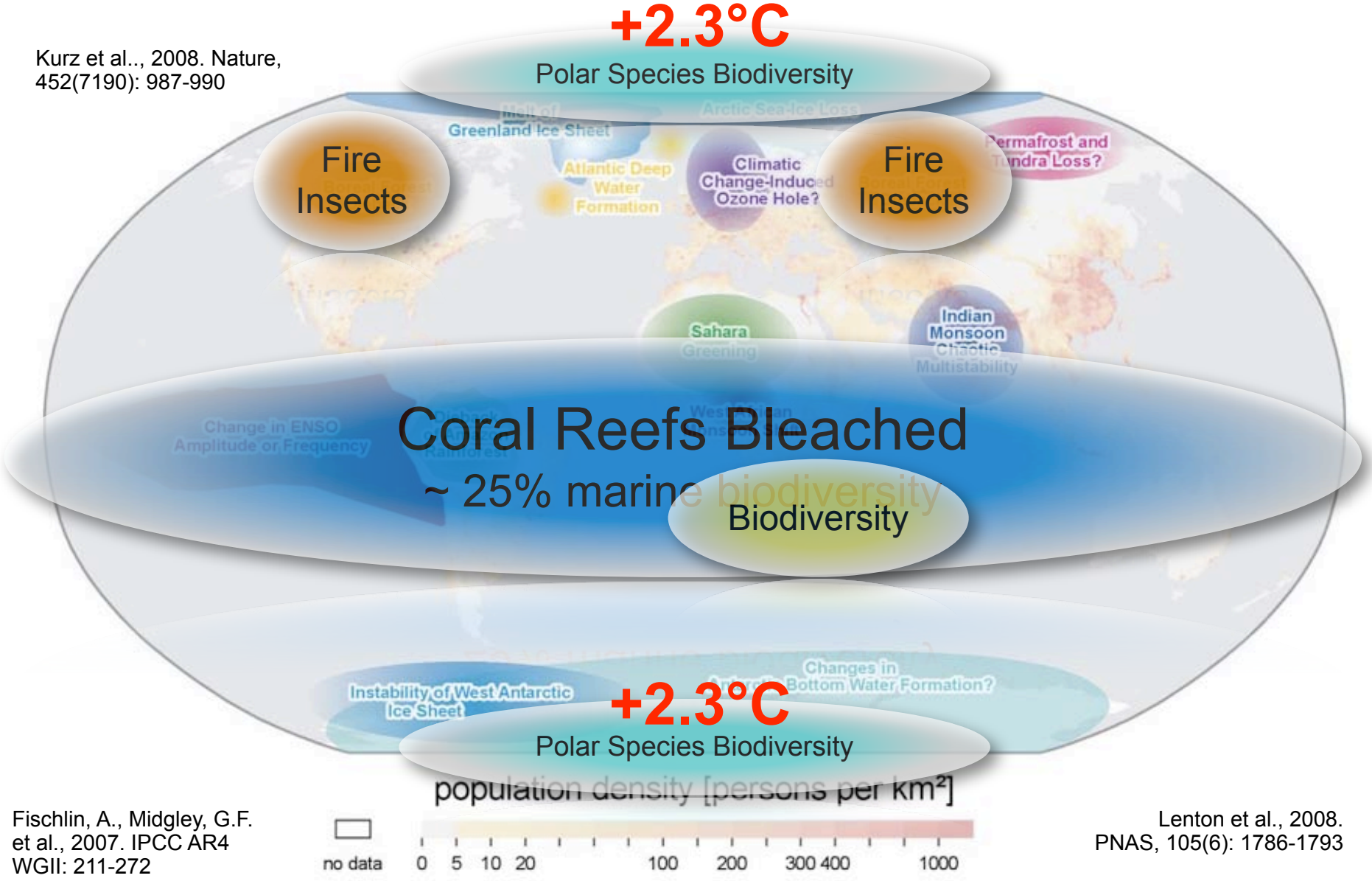


Extinction risks for polar species
Major changes in polar Systems

Fischlin et al. 2007 and Lenton et al. 2008

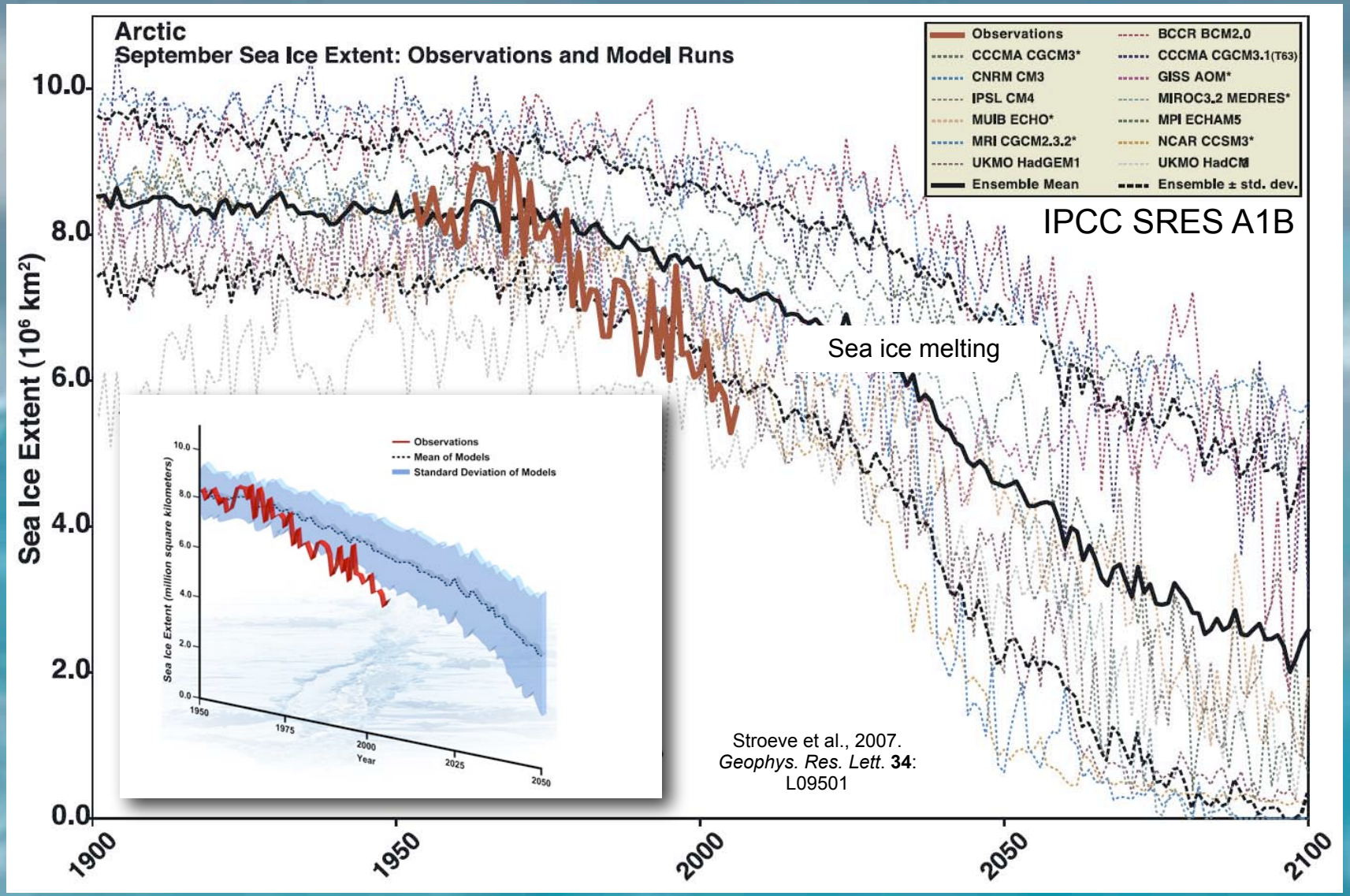
Kurz et al.., 2008. Nature, 452(7190): 987-990



Fischlin, A., Midgley, G.F. et al., 2007. IPCC AR4 WGII: 211-272

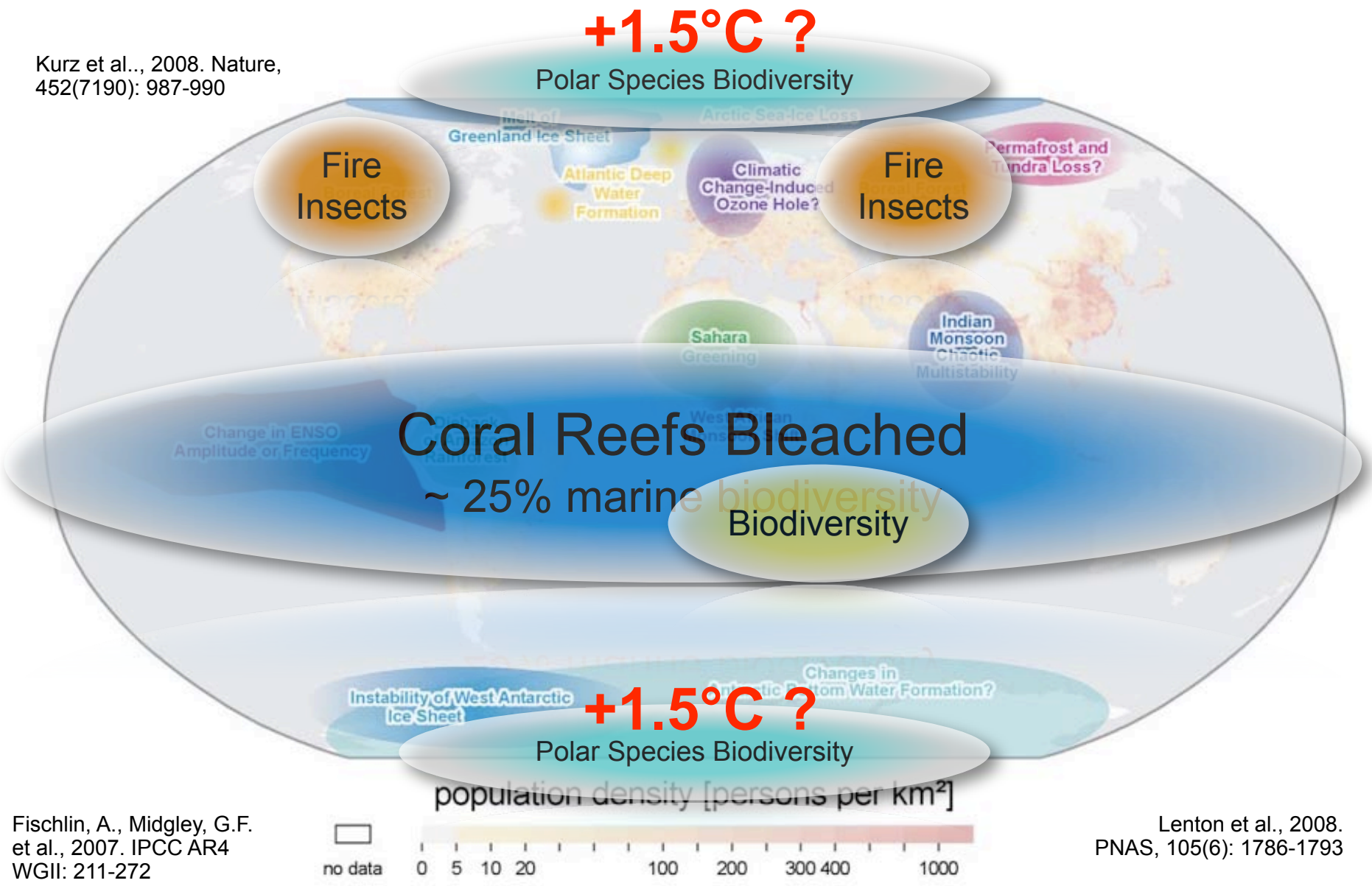
Lenton et al., 2008. PNAS, 105(6): 1786-1793

Observations Indicate We Erred!



Fischlin et al. 2007 and Lenton et al. 2008

Kurz et al.., 2008. Nature, 452(7190): 987-990



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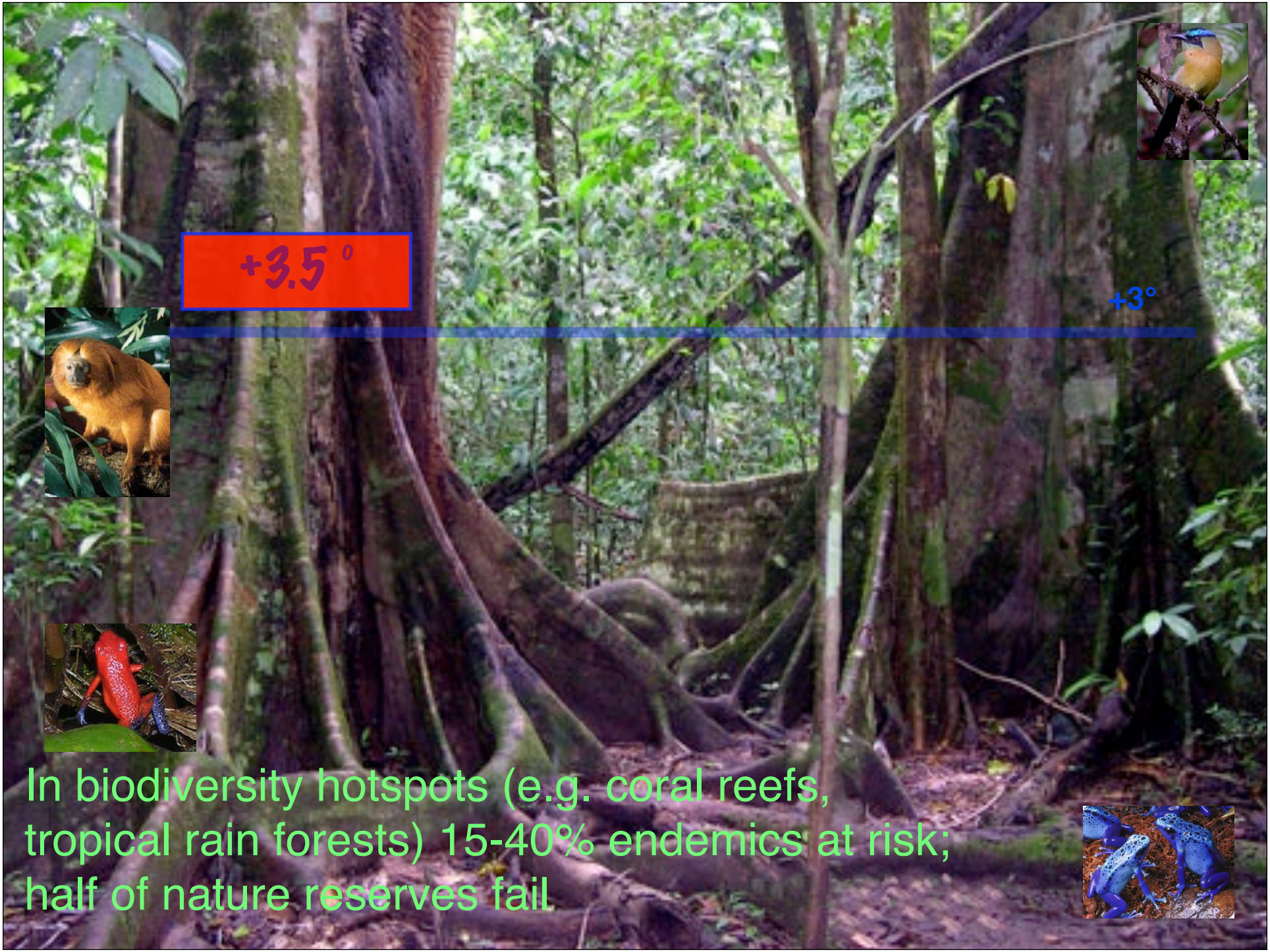
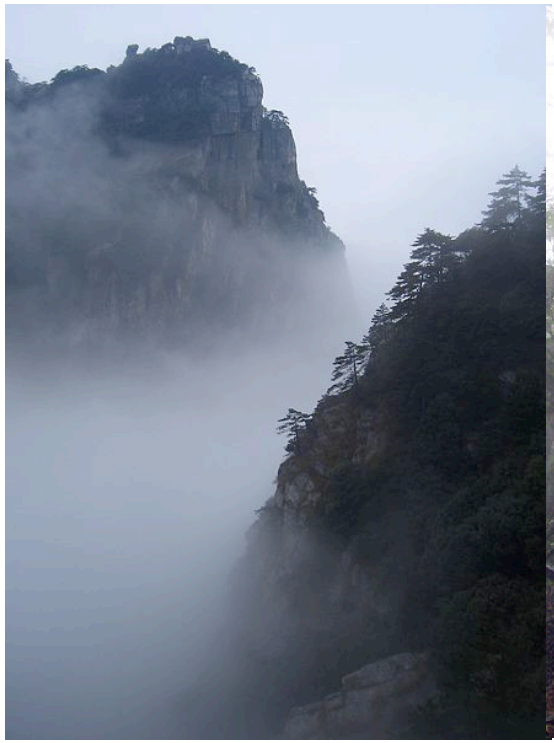


In biodiversity hotspots (e.g. coral reefs, tropical rain forests) 15-40% endemics at risk; half of nature reserves fail

First Evidence:
Recent Climate Change => Extinctions

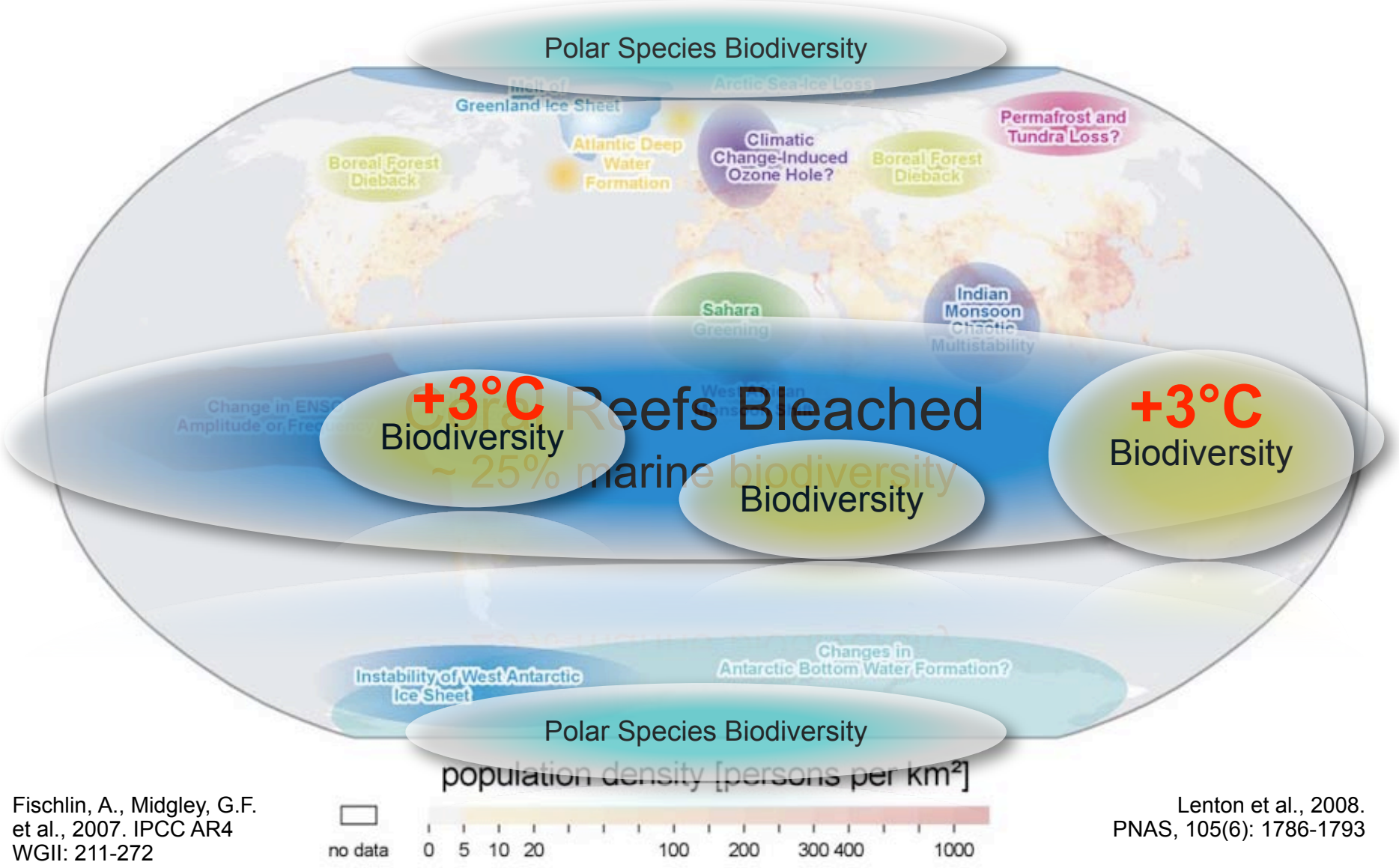
Golden toad and 74 other amphibian species extinct in montane cloud forests
(Pounds *et al.*, 2006; Parmesan, 2006)



Golden toad
(*Bufo periglenes*)

Monteverde harlequin frog
(*Atelopus sp.*)

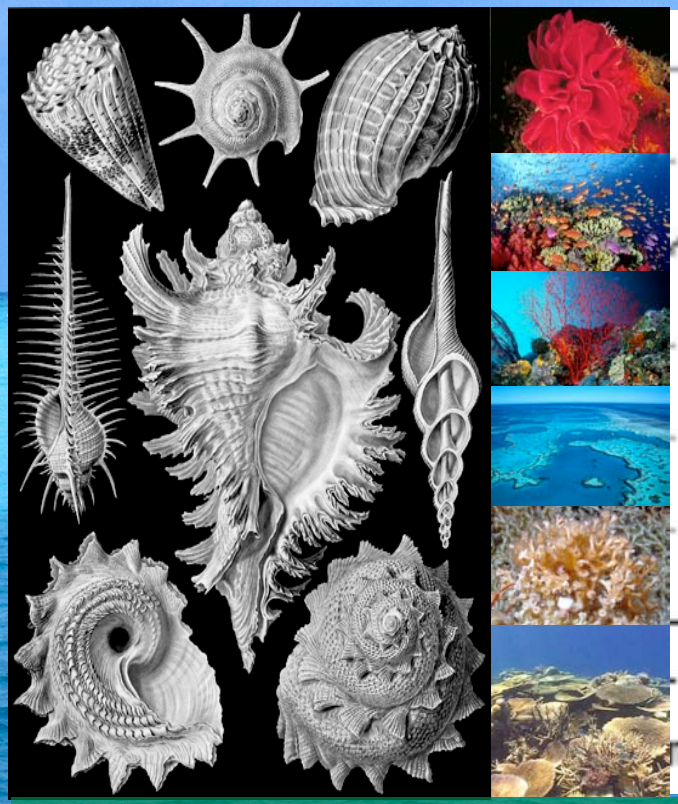
Fischlin et al. 2007 and Lenton et al. 2008

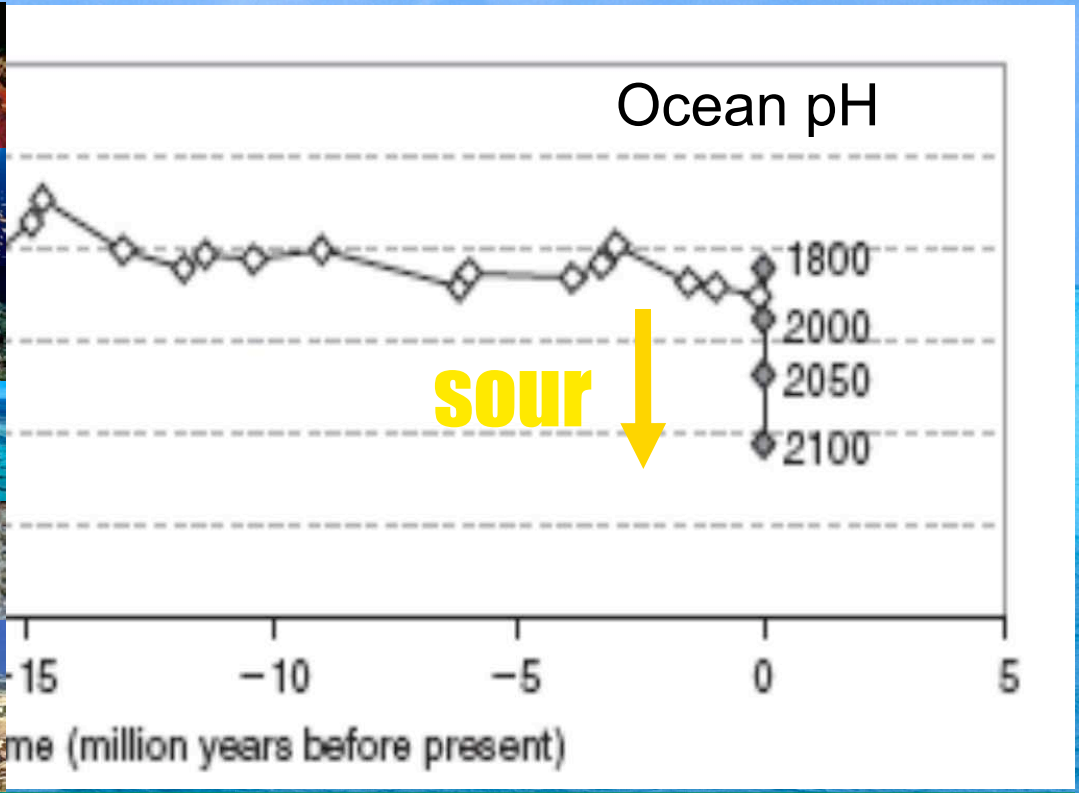


Fischlin, A., Midgley, G.F. et al., 2007. IPCC AR4 WGII: 211-272

Lenton et al., 2008. PNAS, 105(6): 1786-1793

Ocean Acidification



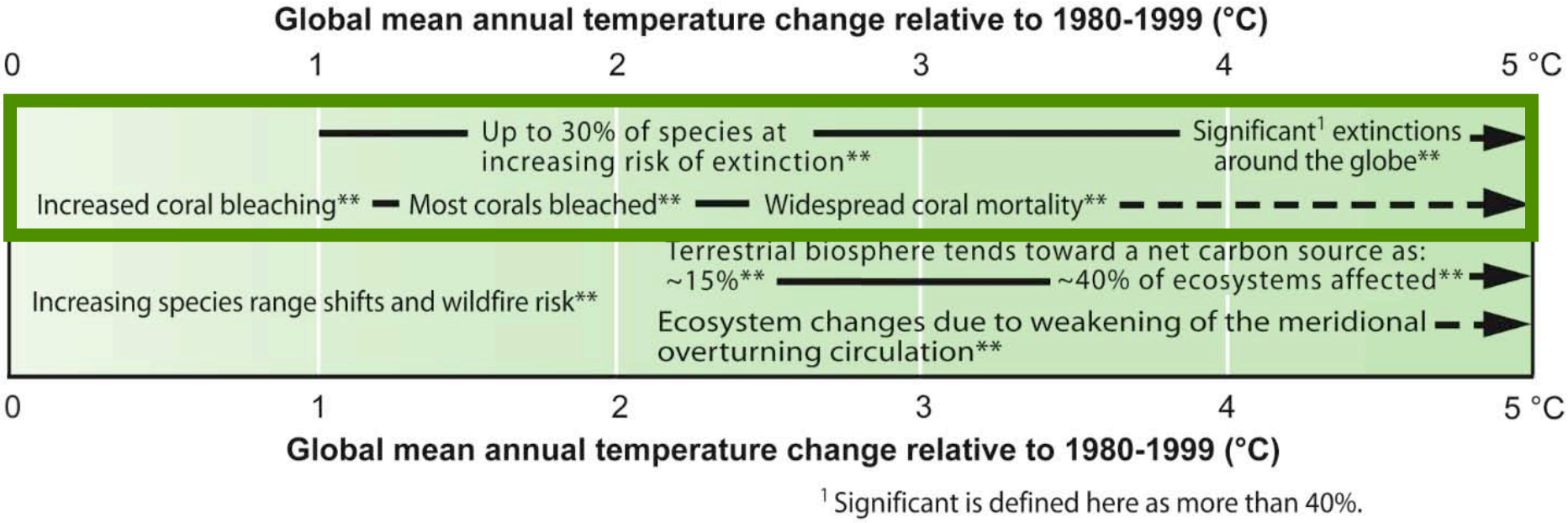


The progressive acidification of oceans due to increasing atmospheric carbon dioxide is expected to have negative impacts on marine shell-forming organisms (e.g., corals) and their dependent species.

IPCC, 2007. SPM WGII, p.11

Summary

Impacts on Biodiversity

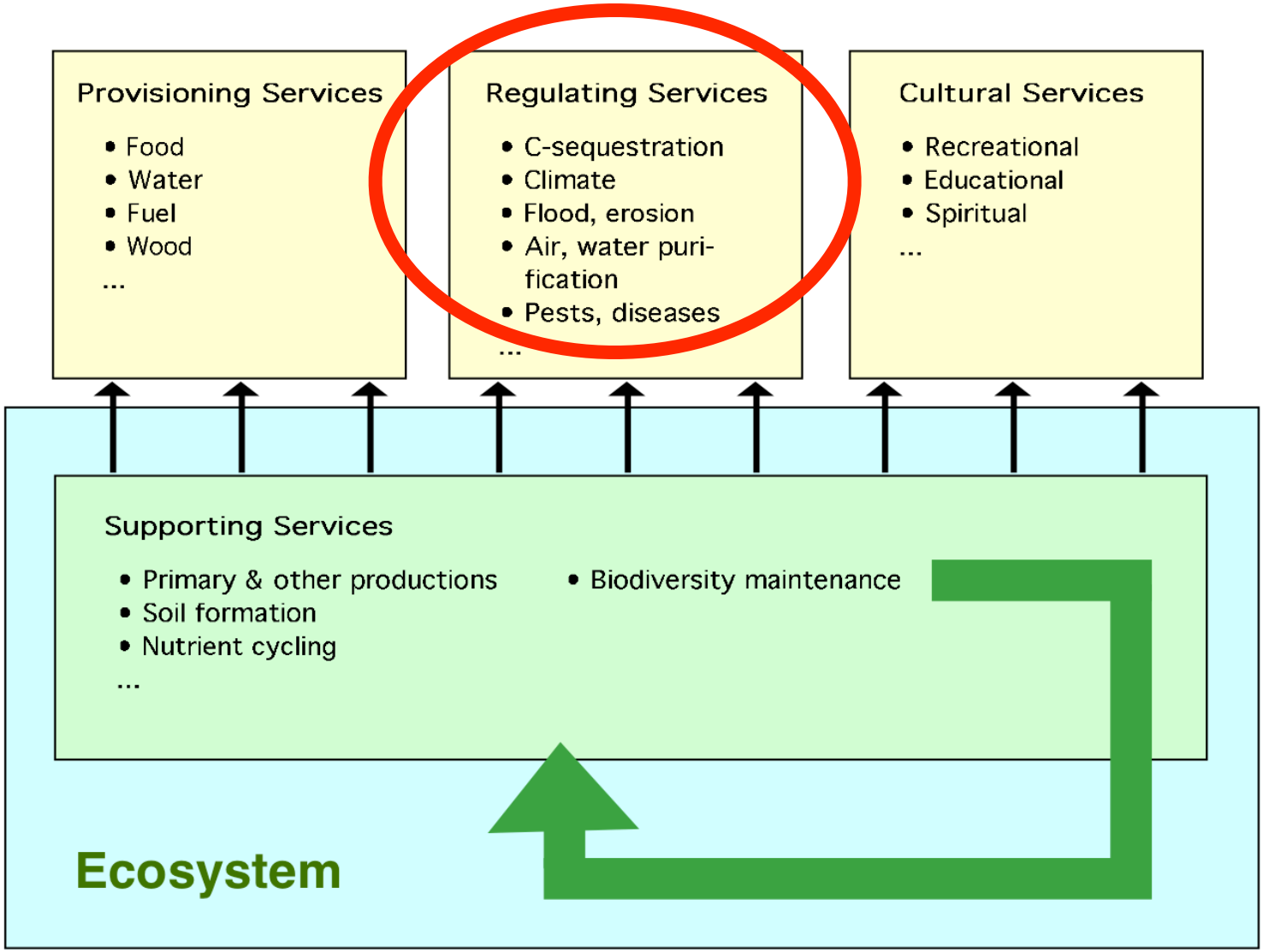


[1] Significant is defined here as more than 40%.

From Figure SPM.2

(IPCC, 2007c. Summary for Policy Makers by Working Group II AR4 IPCC)

Ecosystems Services



Sink Service by Terrestrial Ecosystems

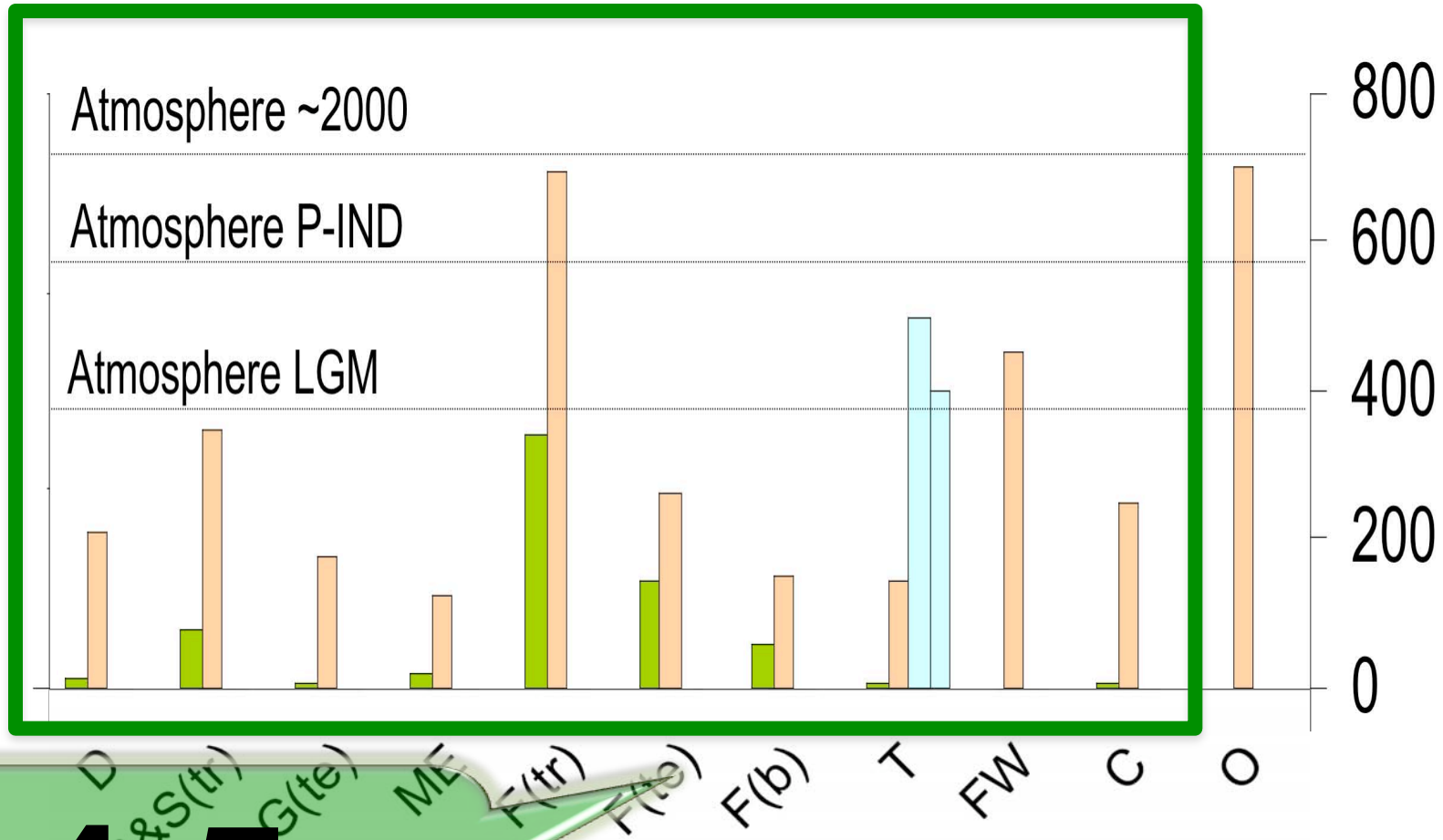
Over the course of this century, net carbon uptake by terrestrial ecosystems is likely to peak before mid-century and then weaken or even reverse, thus amplifying climate change.

(high confidence*)

* Assuming continued greenhouse gas emissions at or above current rates and other global changes including land-use changes

IPCC, 2007. SPM WGII, p.11

Carbon Stored in Land Ecosystems



4.5x **in atmosphere**

Figure 4.1: Ecosystems addressed - C stocks, areal extent

(Fischlin *et al.*, 2007. IPCC WGII)

Some DGVM Results - LPJ A2 HadCM3

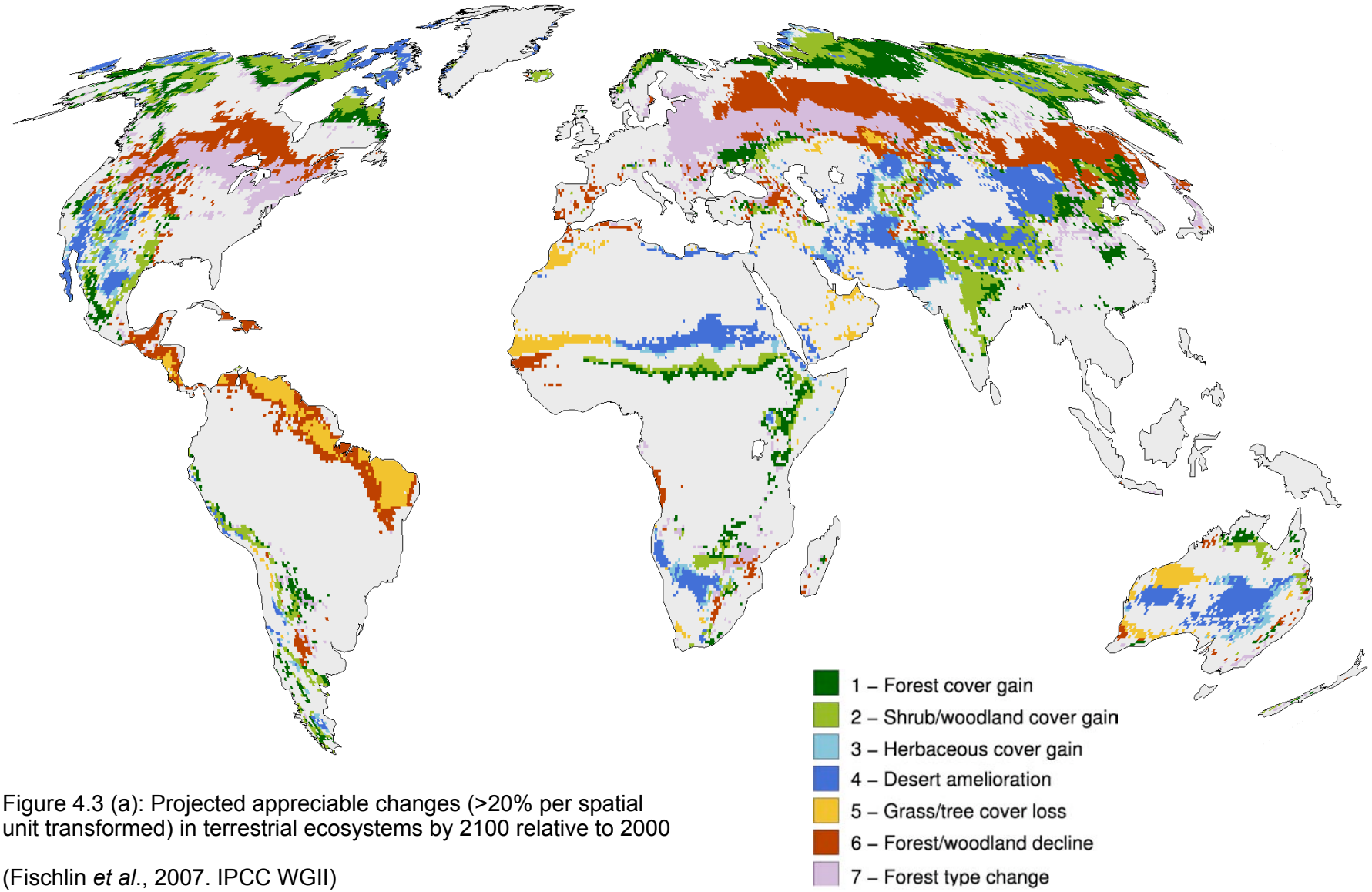


Figure 4.3 (a): Projected appreciable changes (>20% per spatial unit transformed) in terrestrial ecosystems by 2100 relative to 2000

(Fischlin *et al.*, 2007. IPCC WGII)

Sink service at risk

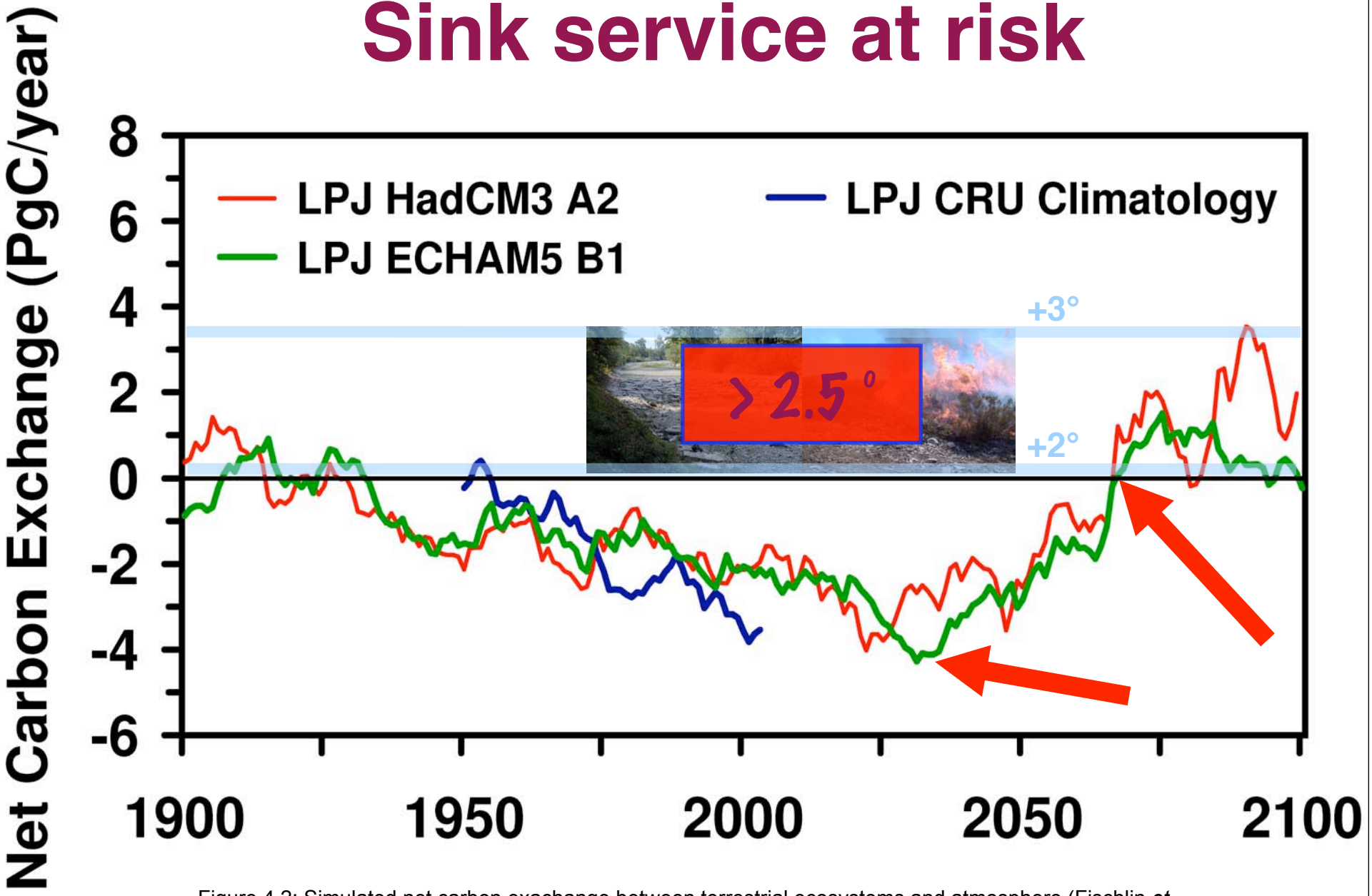
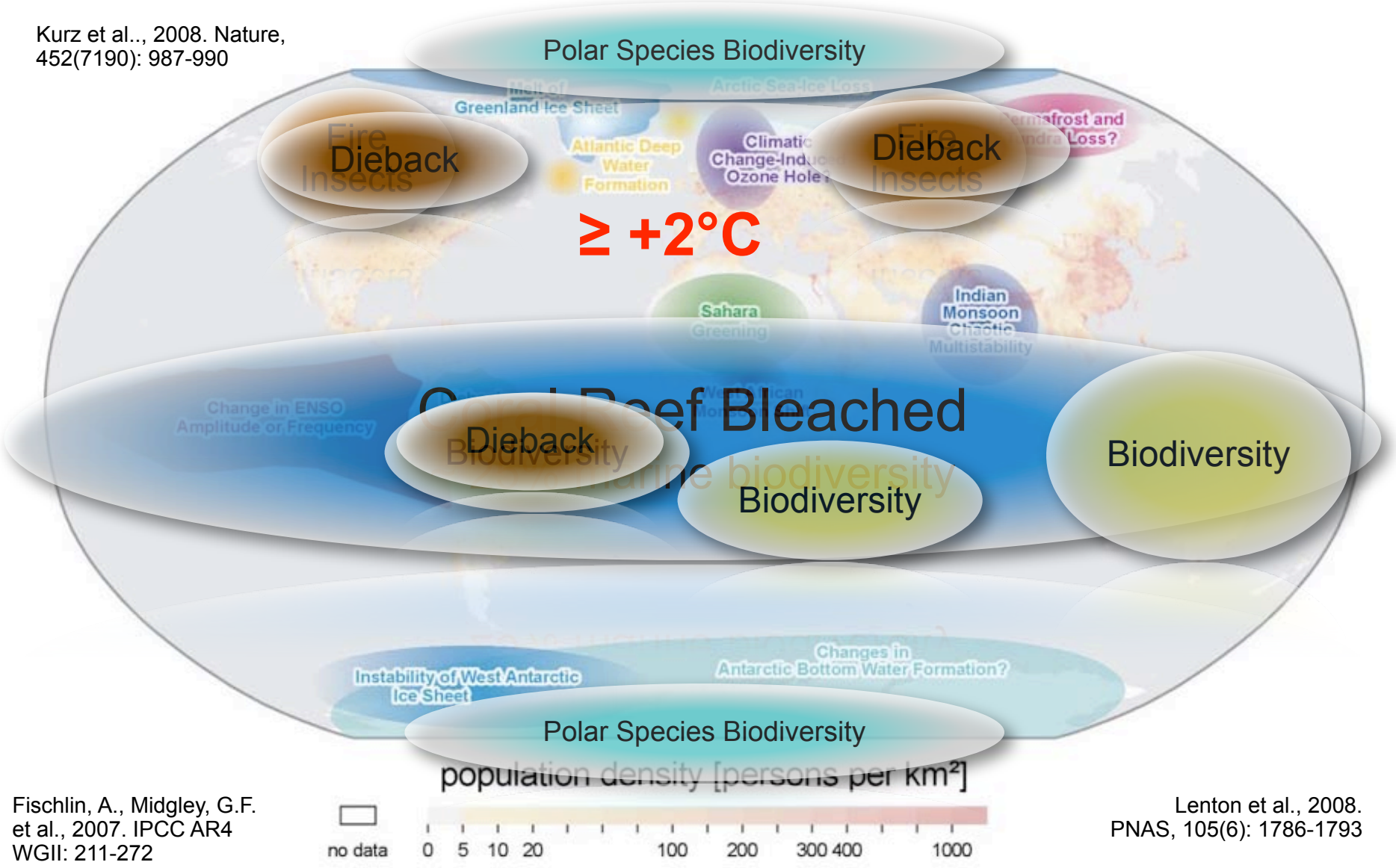


Figure 4.2: Simulated net carbon exachange between terrestrial ecosystems and atmosphere (Fischlin *et al.*, 2007. IPCC WGII)

Fischlin et al. 2007 and Lenton et al. 2008

Kurz et al.., 2008. Nature, 452(7190): 987-990

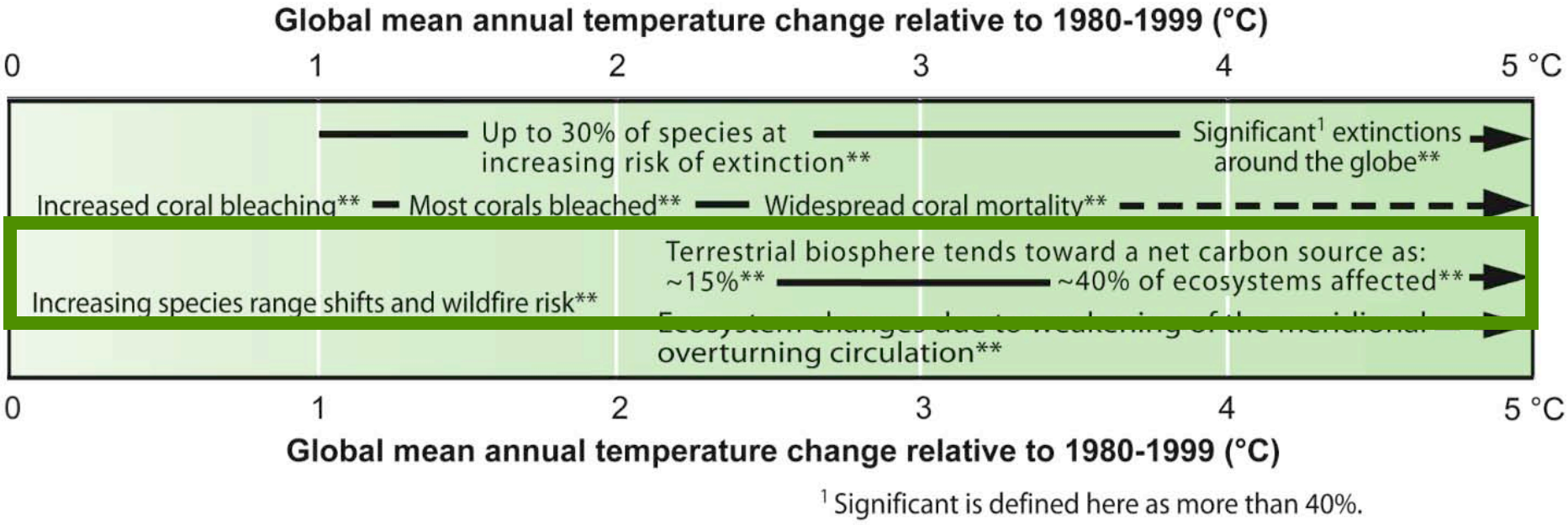


Fischlin, A., Midgley, G.F. et al., 2007. IPCC AR4 WGII: 211-272

Lenton et al., 2008. PNAS, 105(6): 1786-1793

Summary

Changes in Ecosystem Structures and Regulating Services



From Figure SPM.2

(IPCC, 2007c. Summary for Policy Makers by Working Group II AR4 IPCC)

Insect defoliation may release large amounts of carbon into the atmosphere currently not modelled

Section 4.4.5
(Fischlin *et al.*, 2007.
IPCC WGII)

Siberian Frozen Loess Soils (Yedoma)

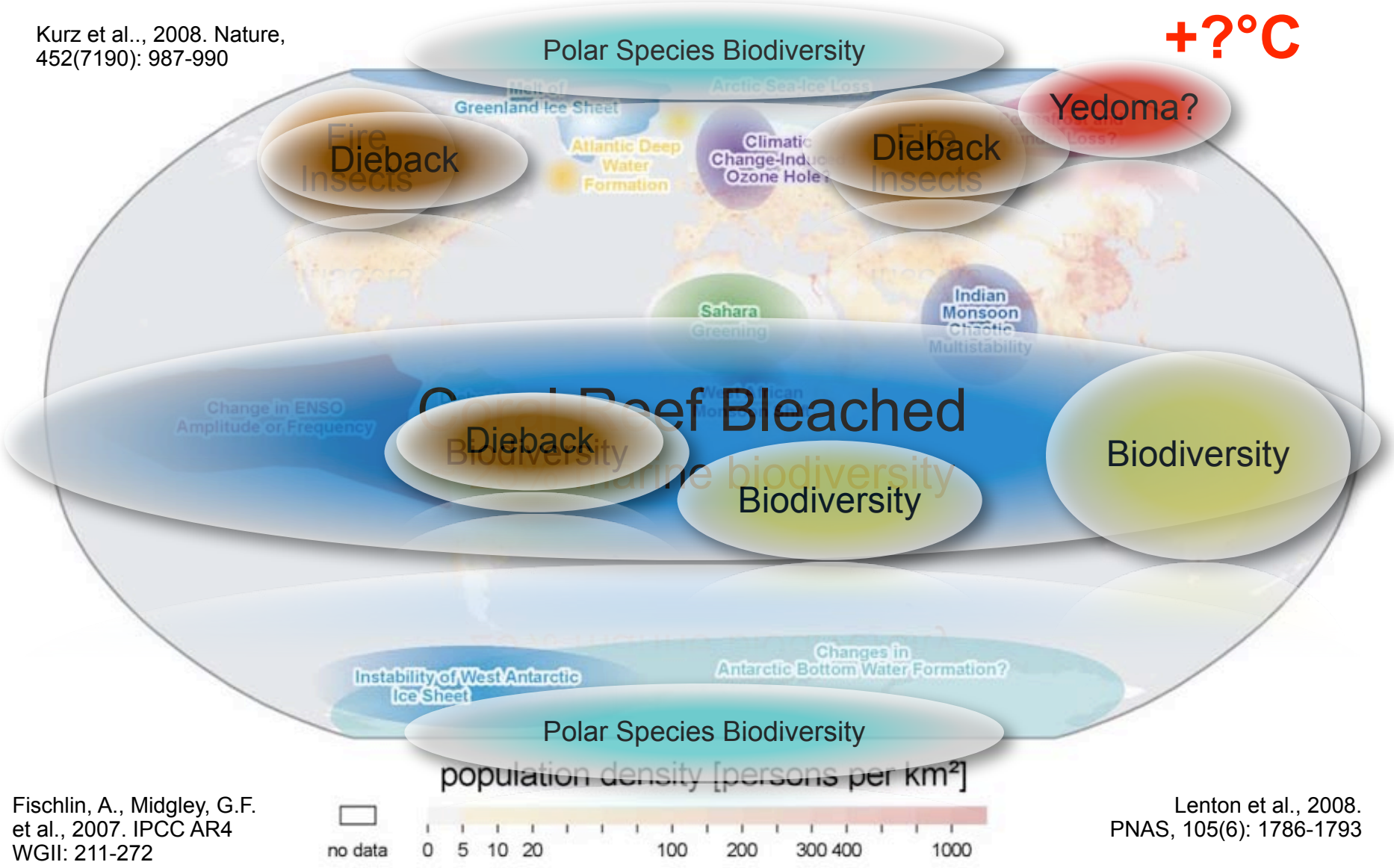
1 million km²
depth up to 25m

C content 2-5%
~ 500 Gt C

Schuur et al., 2008. Bioscience 58: 701-714
Zimov et al., 2006. Science 312: 1612-1613

Fischlin et al. 2007 and Lenton et al. 2008

Kurz et al.., 2008. Nature, 452(7190): 987-990



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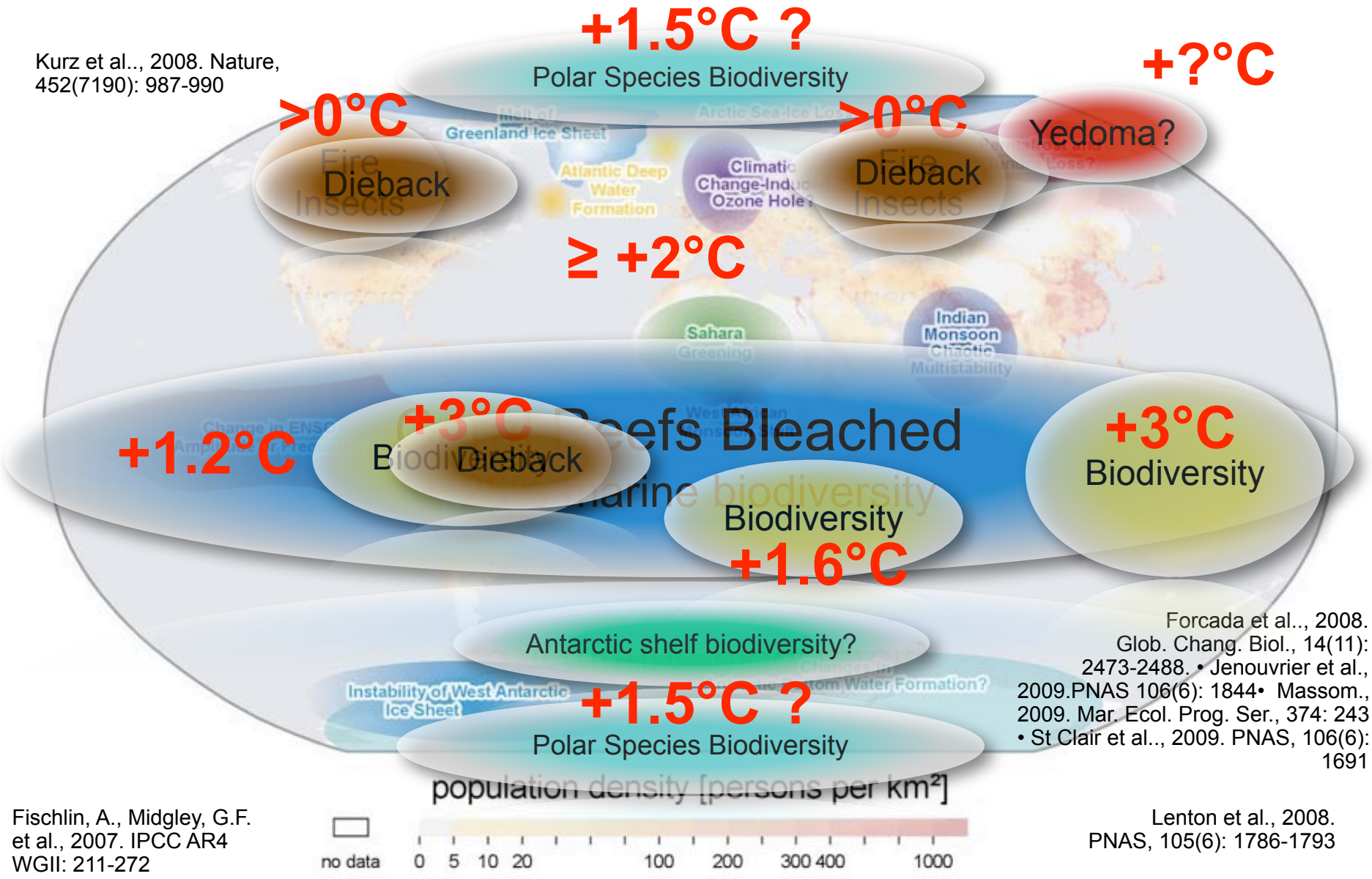

Forcada et al.., 2008. Glob. Chang. Biol., 14(11): 2473-2488. • Jenouvrier et al., 2009.PNAS 106(6): 1844• Massom., 2009. Mar. Ecol. Prog. Ser., 374: 243 • St Clair et al.., 2009. PNAS, 106(6): 1691

Fischlin, A., Midgley, G.F. et al., 2007. IPCC AR4 WGII: 211-272

Lenton et al., 2008. PNAS, 105(6): 1786-1793

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Ecosystem's resilience exceeded <=> can't adapt naturally!

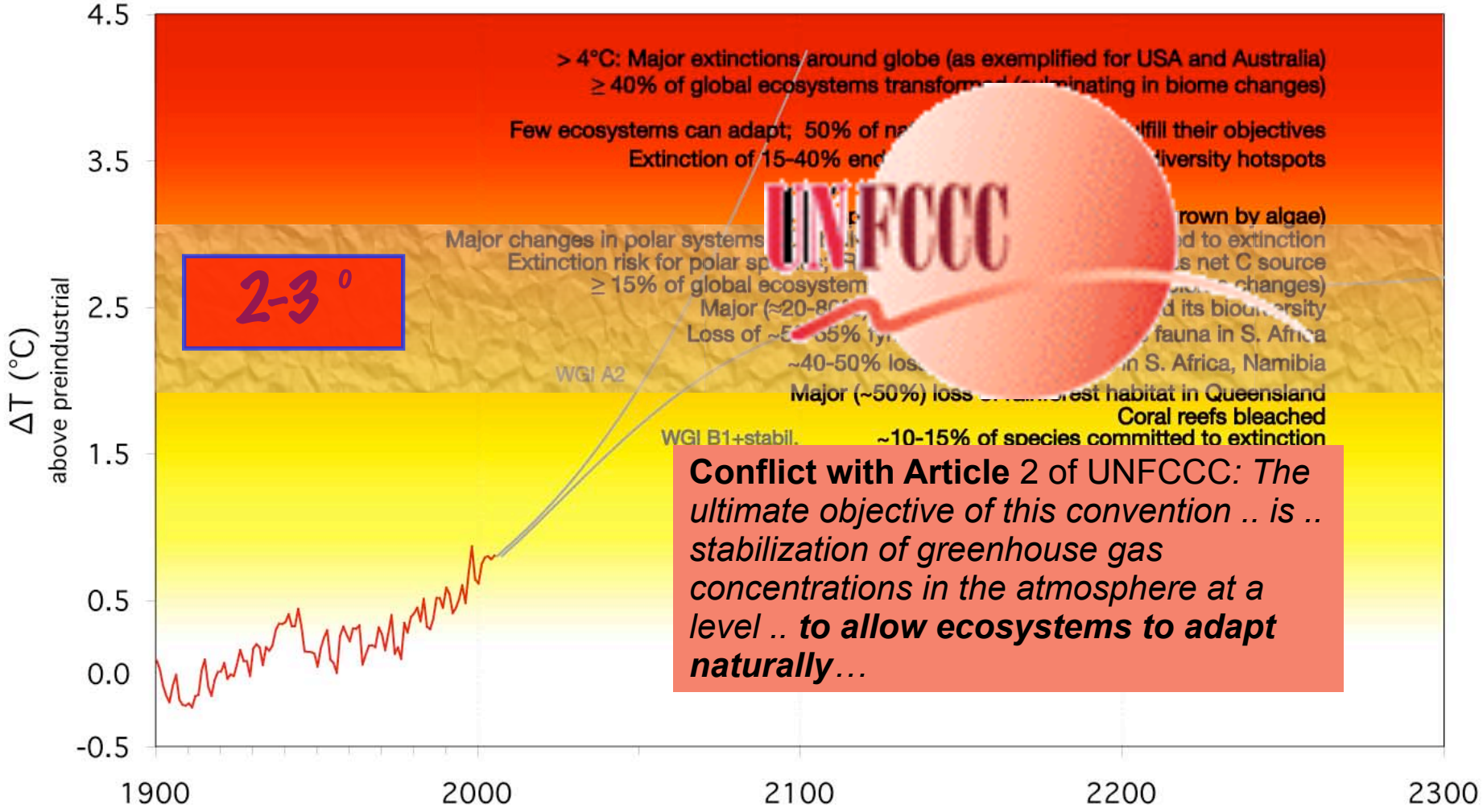

Figure TS.6:Compendium of projected risks due to critical climate change impacts on ecosystems for different levels of global mean annual temperature rise IPCC, 2007d. Technical Summary WGII

Thanks for your attention!

www.ipcc.ch
www.sysecol.ethz.ch
andreas.fischlin@env.ethz.ch