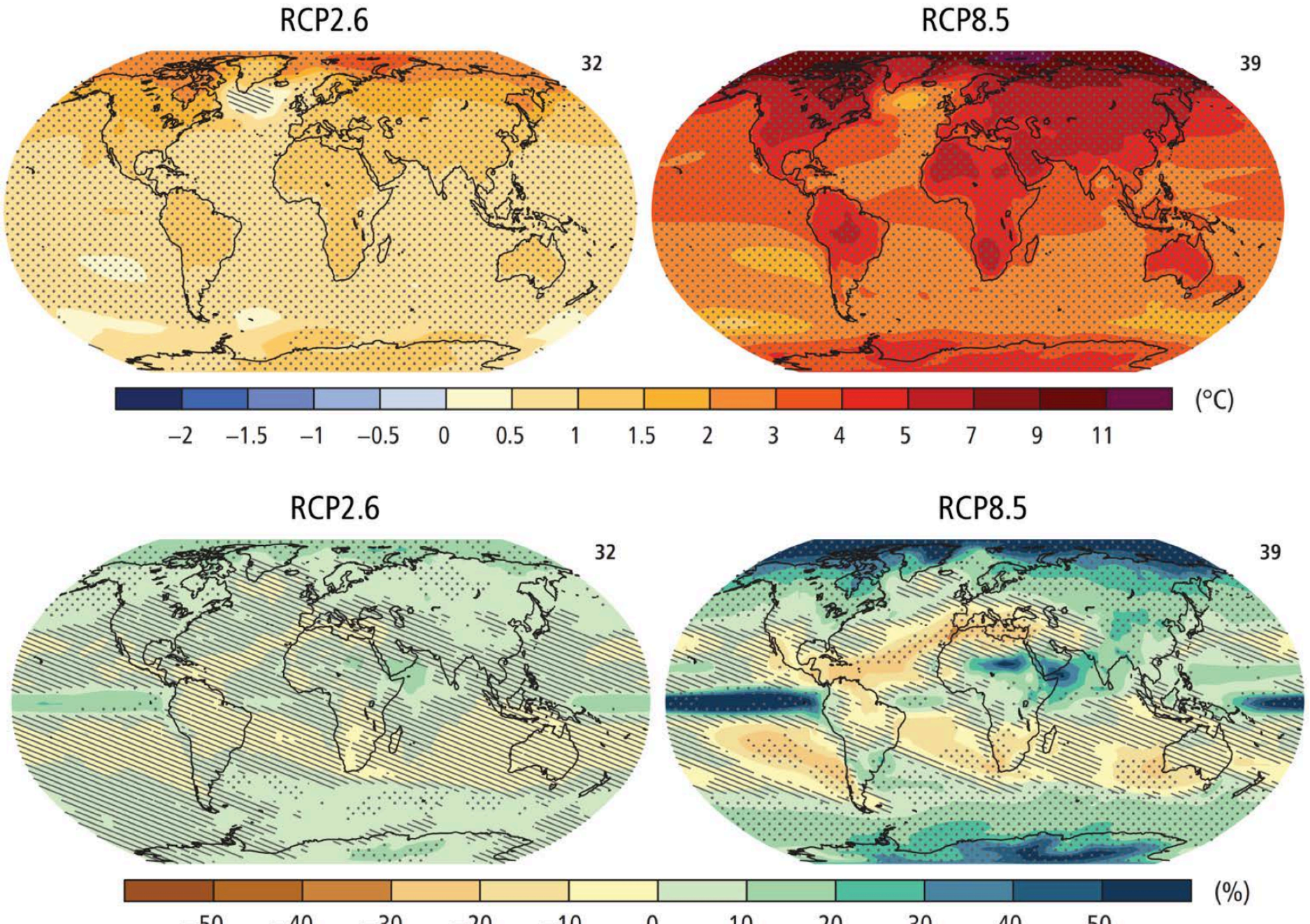
Impacts of Climate Change on Ecosystem Services

Wrap-up

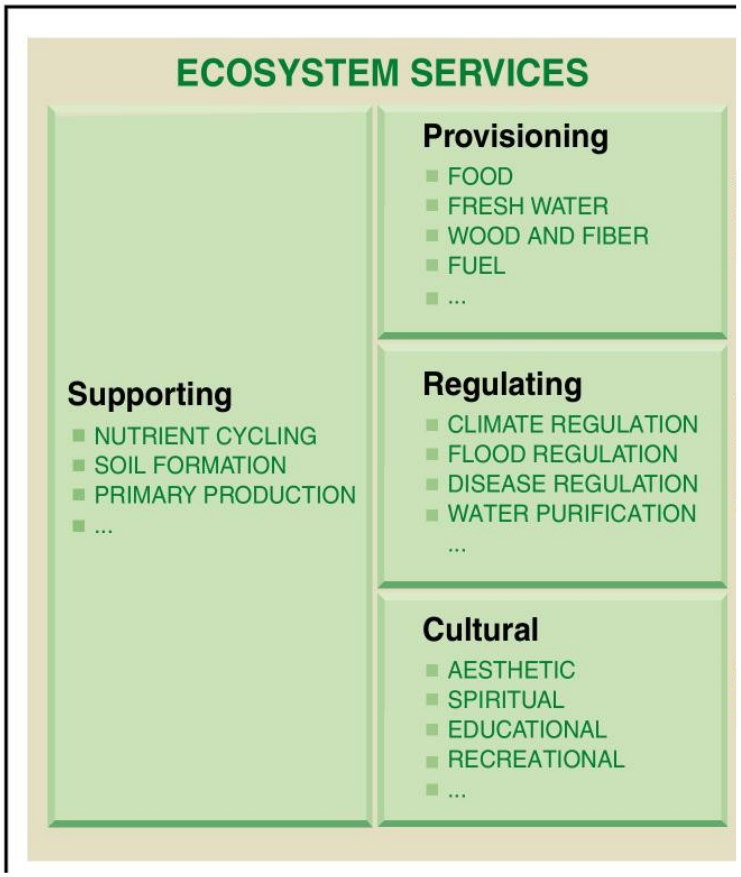
Alessandro Cescatti

Joint Research Centre, European Commission
Institute for the Environment and Sustainability
Climate Risk Management Unit

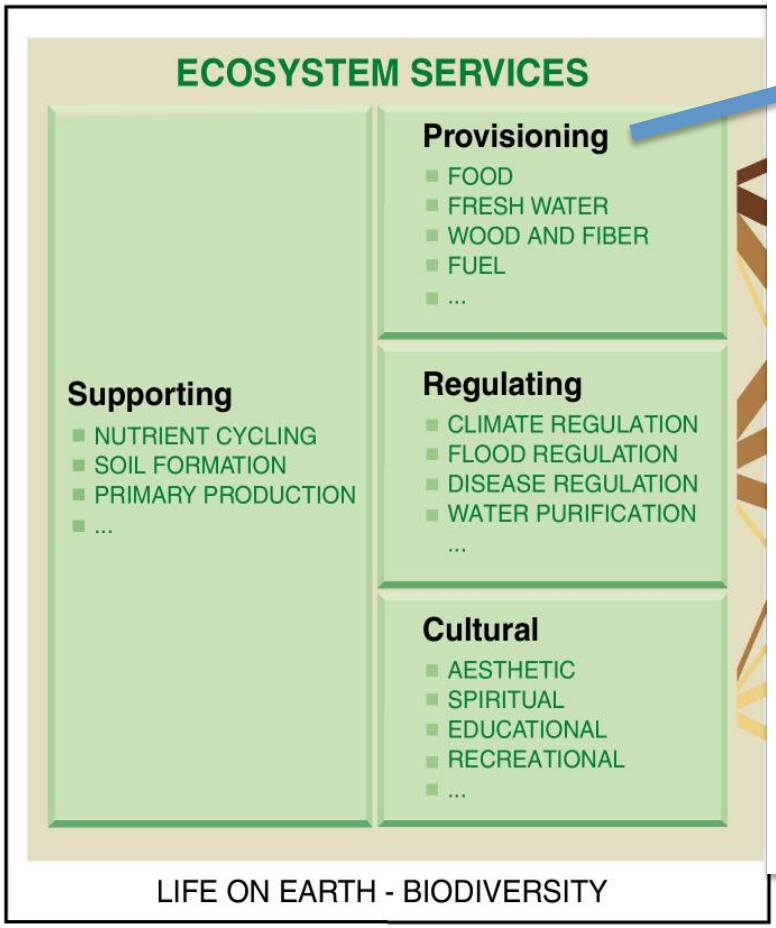
Politecnico di Milano *23 June, 2015*


RCP2.6
32
RCP8.5
39
(°C)
−2 −1.5 −1 −0.5 0 0.5 1 1.5 2 3 4 5 7 9 11
RCP2.6
32
RCP8.5
39
(%)
−50 −40 −30 −20 −10 0 10 20 30 40 50

Millenium Ecosystem Assessment



Millenium Ecosystem Assessment



Service		Status
Food	crops	↑
	livestock	↑
	capture fisheries	↓
	aquaculture	↑
	wild foods	↓
Fiber	timber	+/–
	cotton, silk	+/–
	wood fuel	↓
Genetic resources		↓
Biochemicals, medicines		↓
Fresh water		↓

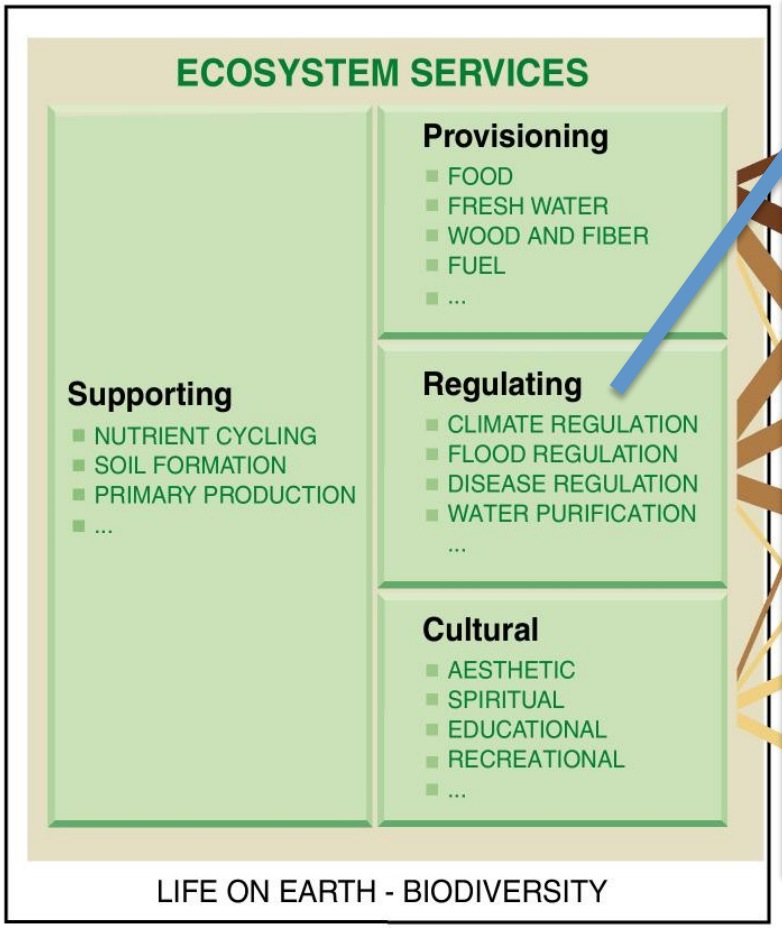
ARROW'S COLOR
Potential for mediation by socioeconomic factors

- Low
- Medium
- High

ARROW'S WIDTH
Intensity of linkages between ecosystem services and human well-being

- Weak
- Medium
- Strong

Millenium Ecosystem Assessment



ARROW'S COLOR
Potential for mediation by socioeconomic factors

- Low
- Medium
- High

ARROW'S WIDTH
Intensity of linkages between ecosystem services and human well-being

- Weak
- Medium
- Strong

	Status
Regulating Services	
Air quality regulation	↓
Climate regulation – global	↑
Climate regulation – regional and local	↓
Water regulation	+/–
Erosion regulation	↓
Water purification and waste treatment	↓
Disease regulation	+/–
Pest regulation	↓
Pollination	↓
Natural hazard regulation	↓
Cultural Services	
Spiritual and religious values	↓
Aesthetic values	↓
Recreation and ecotourism	+/–

Ecosystems Services

Global GDP 1997

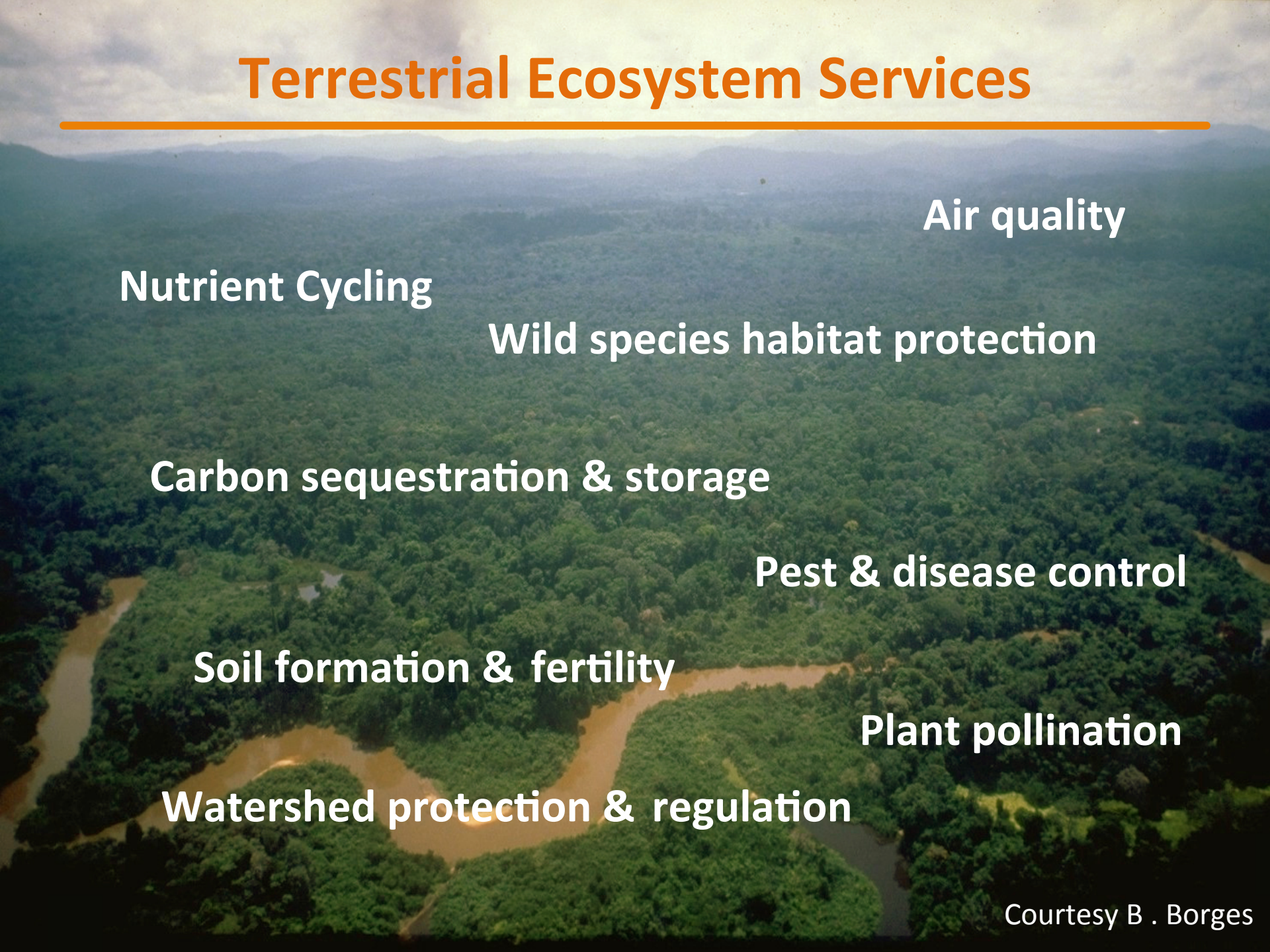
18

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

16 33 54

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

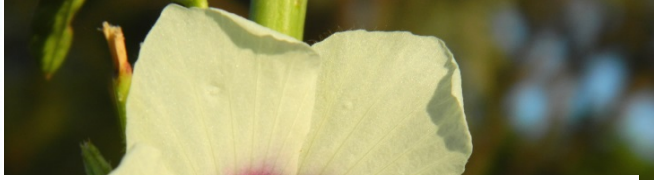
Terrestrial Ecosystem Services



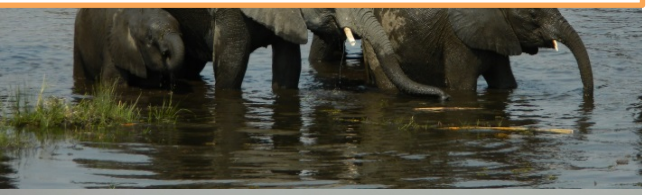
Marine and Coastal Ecosystem Services

Courtesy B . Borges

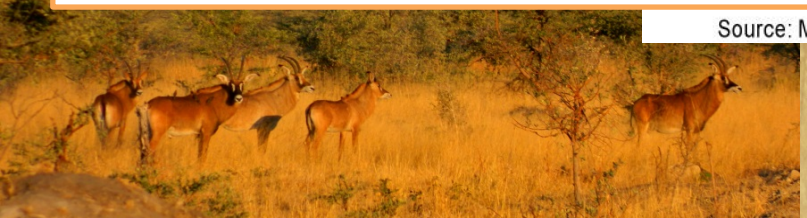
CLIMATE CHANGE AND BIODIVERSITY

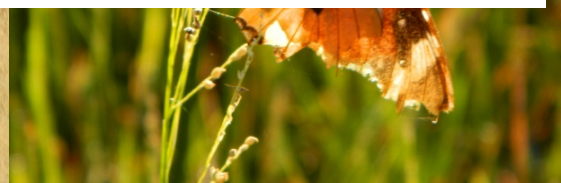


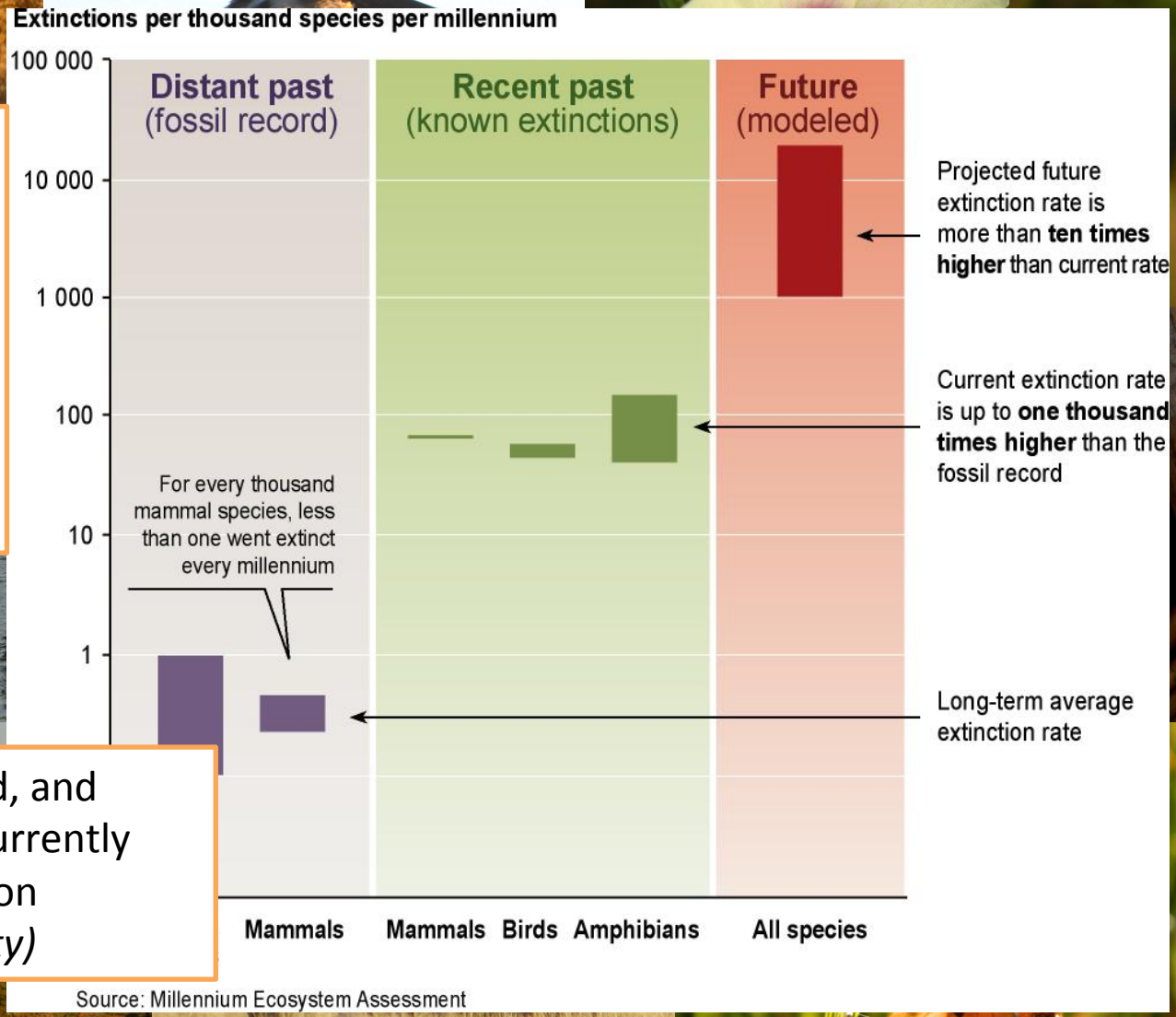
Humans have increased the species extinction rate by as much as 1,000 times over background rates typical over the planet's history (*medium certainty)*



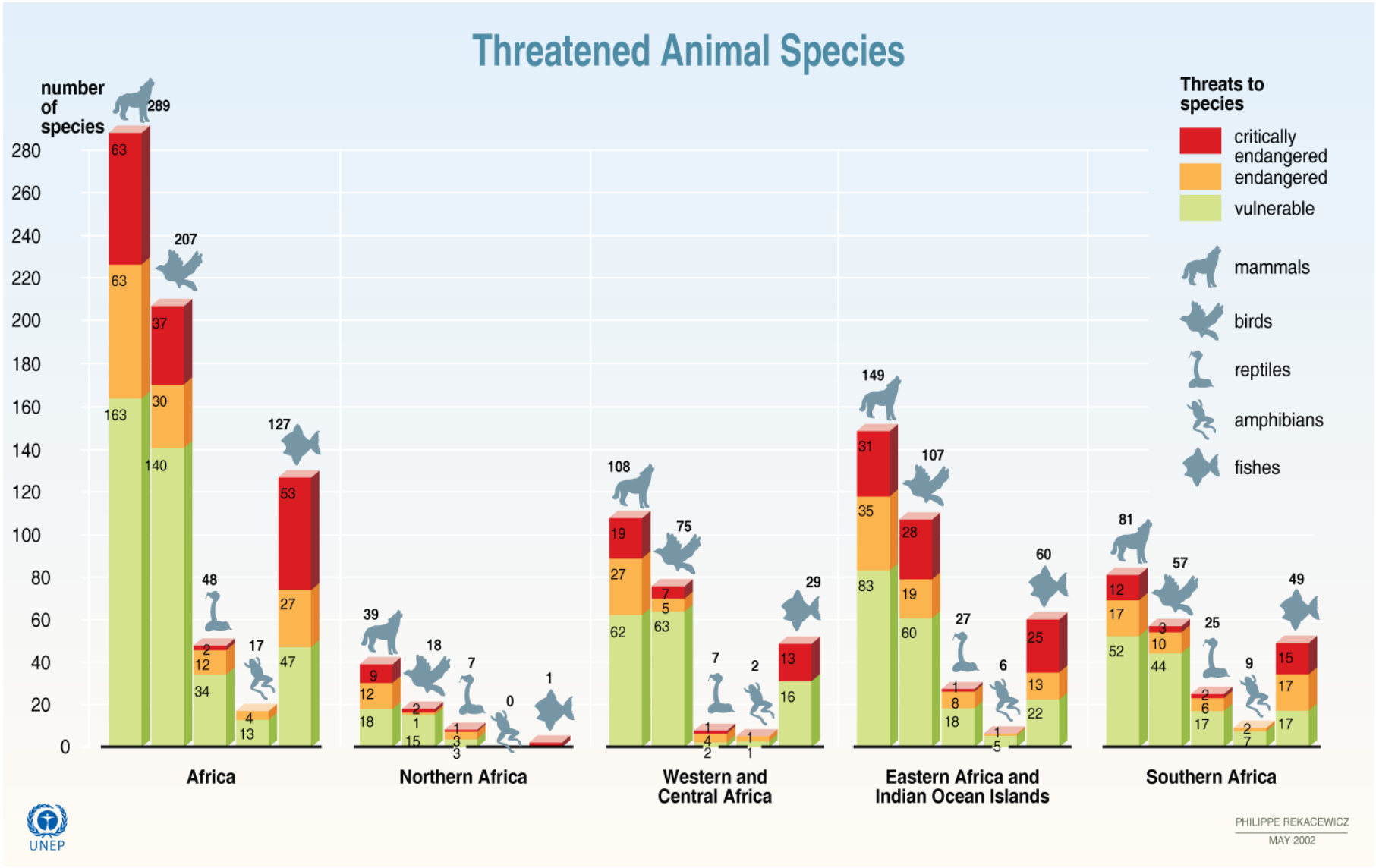
10–30% of mammal, bird, and amphibian species are currently threatened with extinction (*medium to high certainty)*







Potential loss of biodiversity

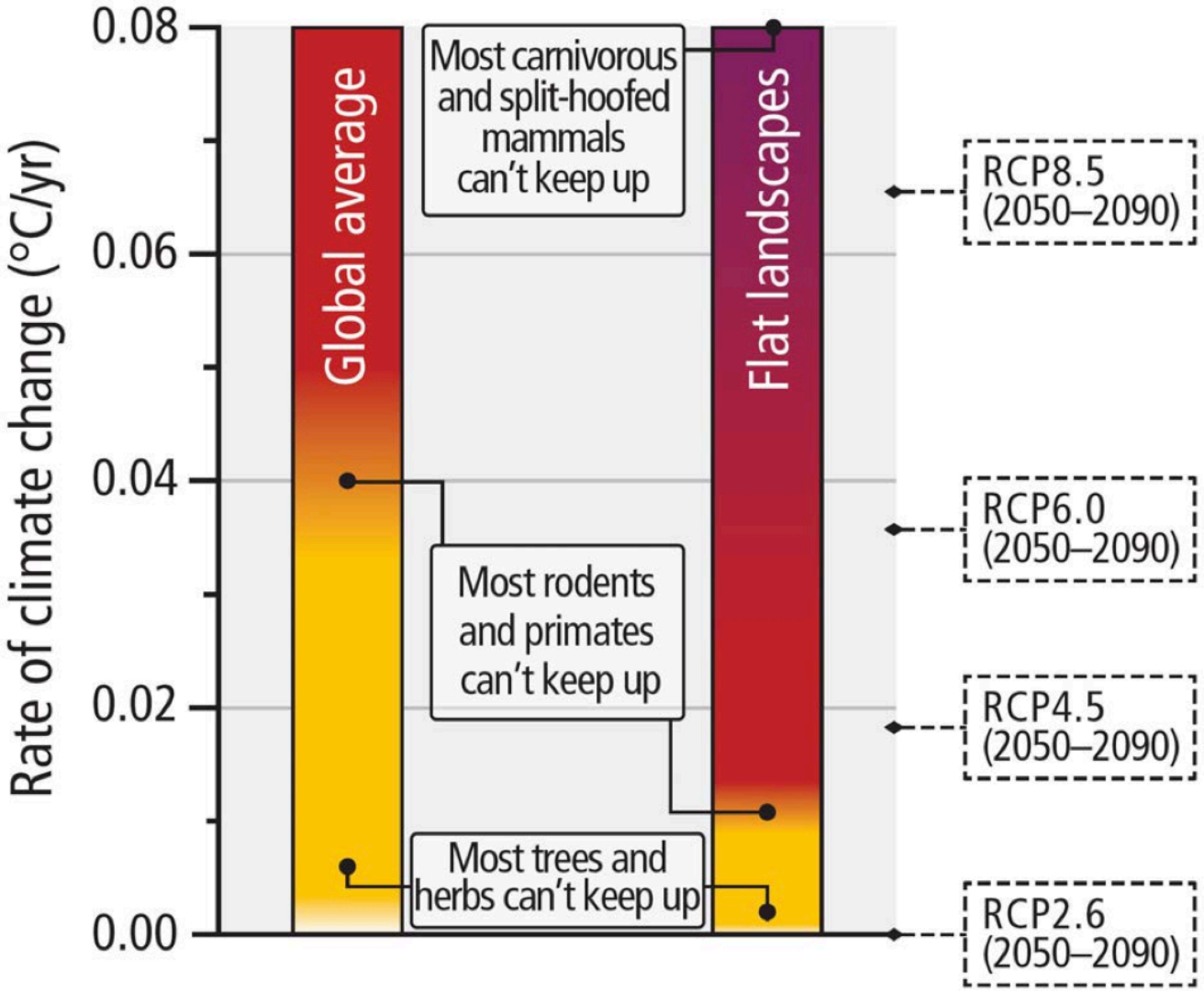


Sources: WCM/UICN-The World Conservation Union, 1998.

Different Kinds of Extinction in the Sea

- **Commercial extinction:** When a species becomes so rare that it no longer pays to hunt it.
- **Ecological extinction:** When a species becomes so rare that it no longer plays its normal ecological role.

Risk for terrestrial and freshwater species impacted by the rate of warming



IPCC, 2014. SYR AR5, Figure 2.5

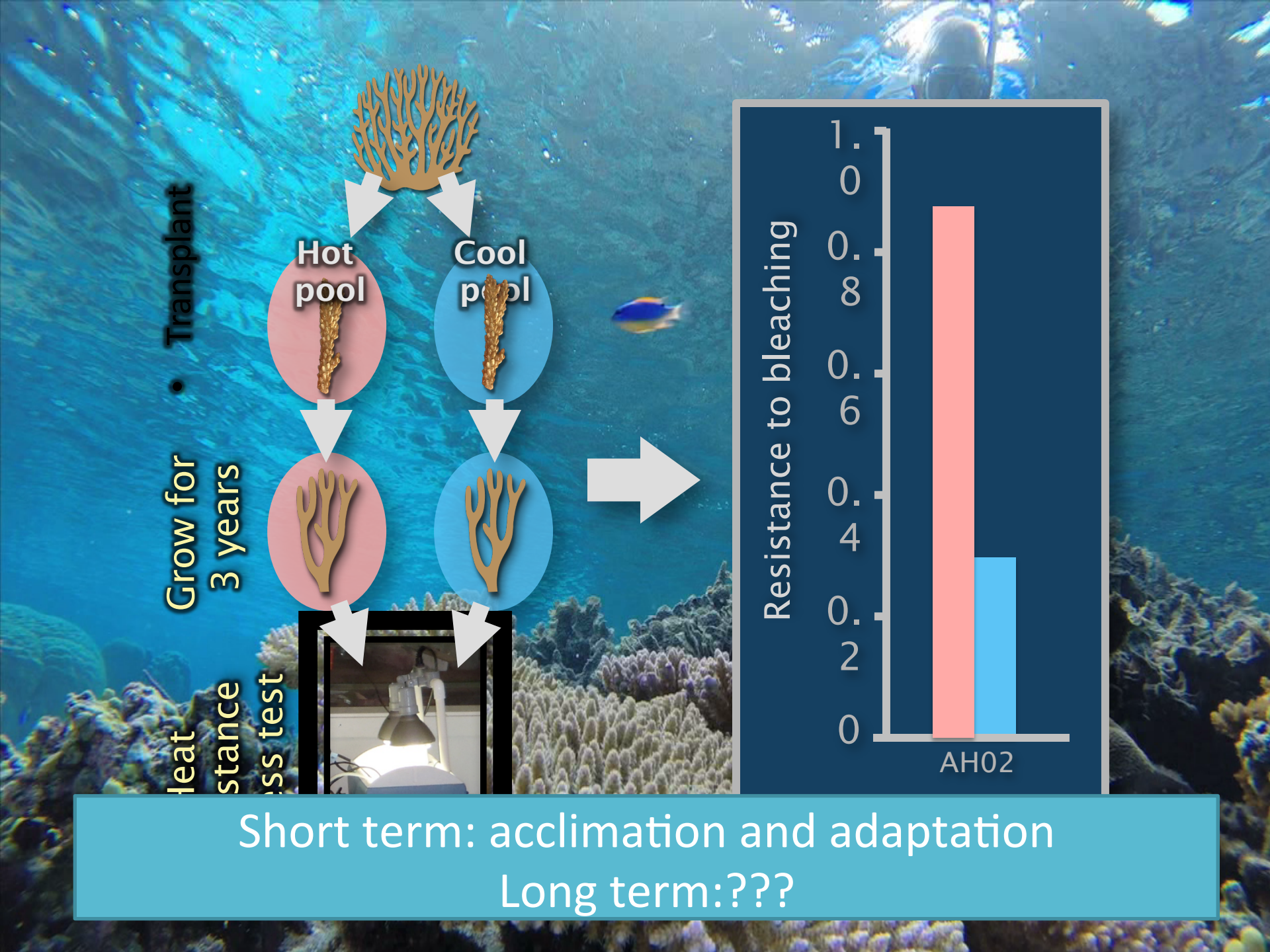
Natural Systems in Changing Climates
www.sciencemag.org/special/climate2013

REVIEW

Climate Change and Infectious Diseases: From Evidence to a Predictive Framework

Sonia Altizer,[1]* Richard S. Ostfeld,[2] Pieter T. J. Johnson,[3] Susan Kutz,[4] C. Drew Harvell[5]

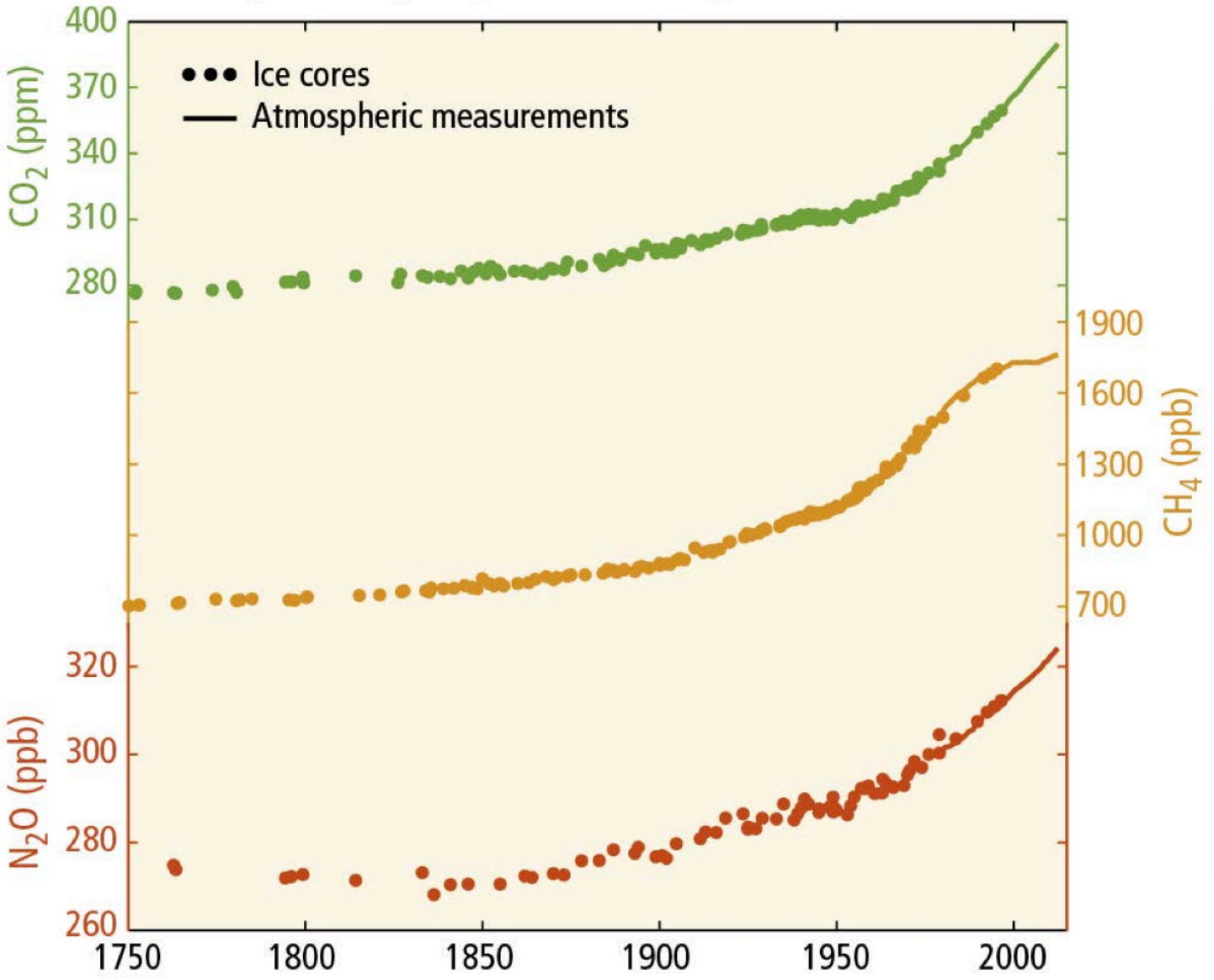
Scientists have long predicted large-scale responses of infectious diseases to climate change, giving rise to a polarizing debate, especially concerning human pathogens for which socioeconomic drivers and control measures can limit the detection of climate-mediated changes. Climate change has already increased the occurrence of diseases in some natural and agricultural systems, but in many cases, outcomes depend on the form of climate change and details of the host-pathogen system. In this review, we highlight research progress and gaps that have emerged during the past decade and develop a predictive framework that integrates knowledge from ecophysiology and community ecology with modeling approaches. Future work must continue to anticipate and monitor pathogen biodiversity and disease trends in natural ecosystems and identify opportunities to mitigate the impacts of climate-driven disease emergence.



Short term: acclimation and adaptation

Long term:???

Biogeochemical cycles C and N



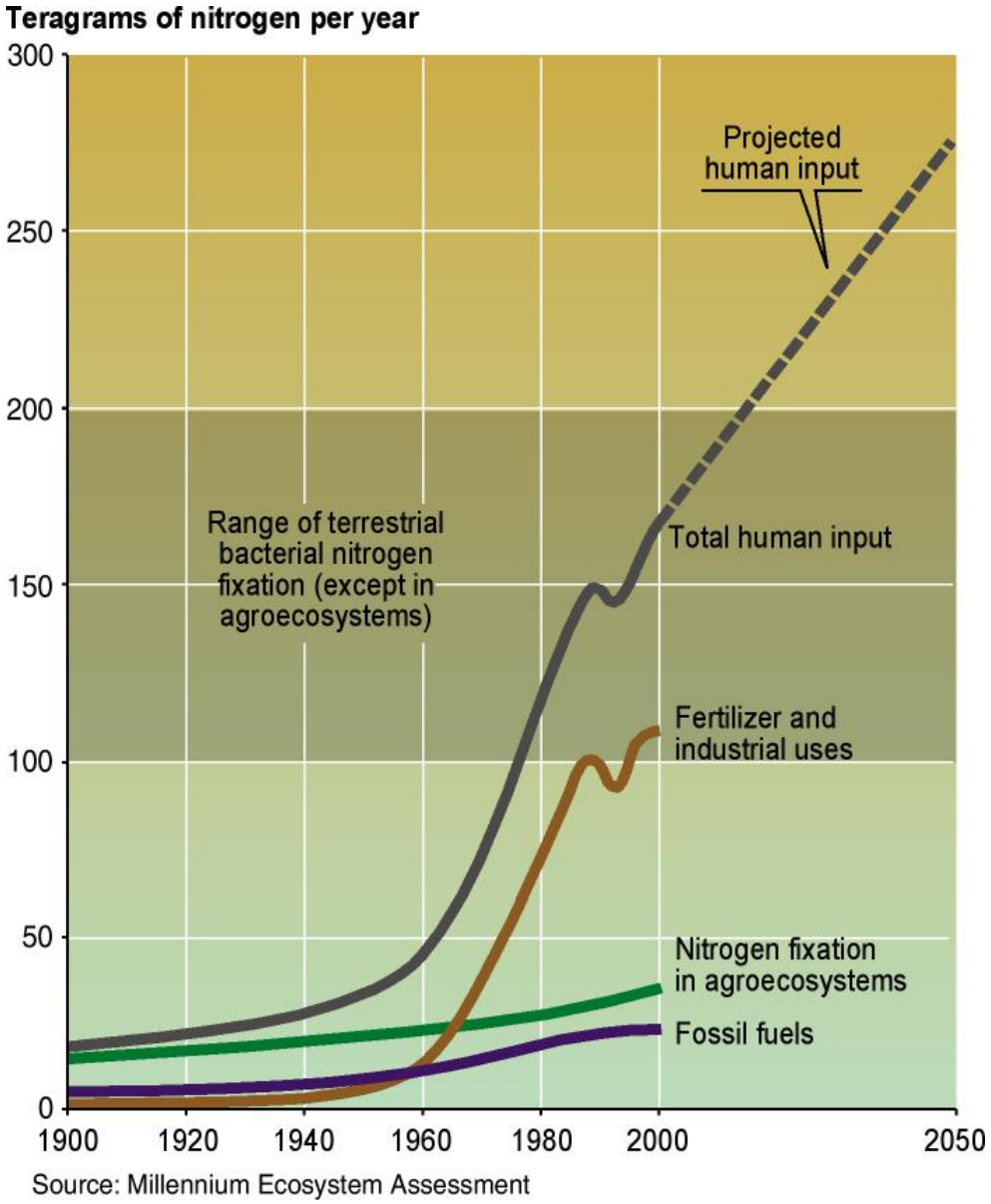
Biogeochemical cycles C and N

Since 1960:

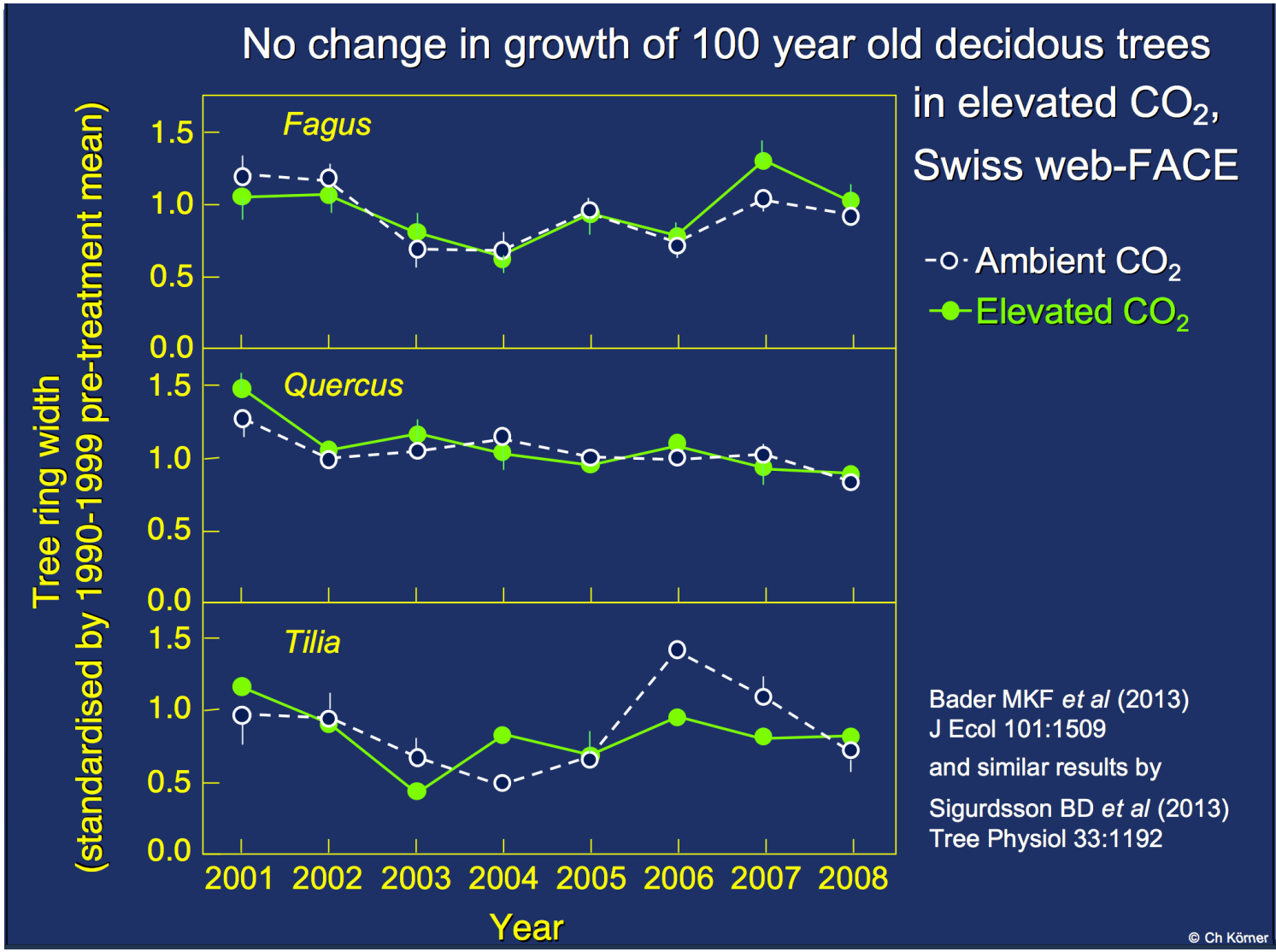
- Flows of biologically available nitrogen in terrestrial ecosystems doubled
- Flows of phosphorus tripled

> 50% of all the synthetic nitrogen fertilizer ever used has been used since 1985

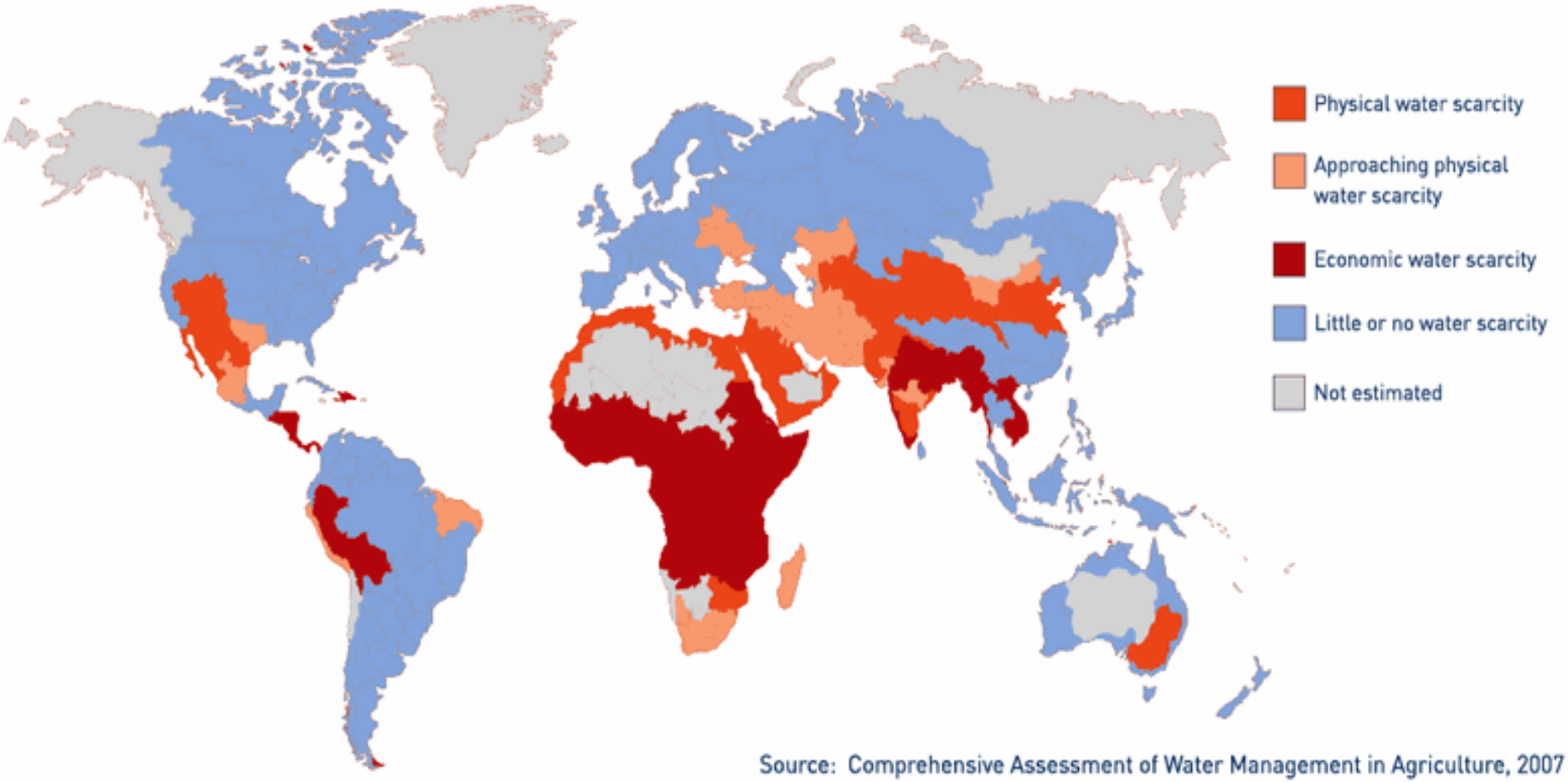
•60% of the increase in the atmospheric concentration of CO_2 since 1750 has taken place since 1959



Forest productivity is not C limited…
there is no green solution to the CO2-problem.
Christian Körner

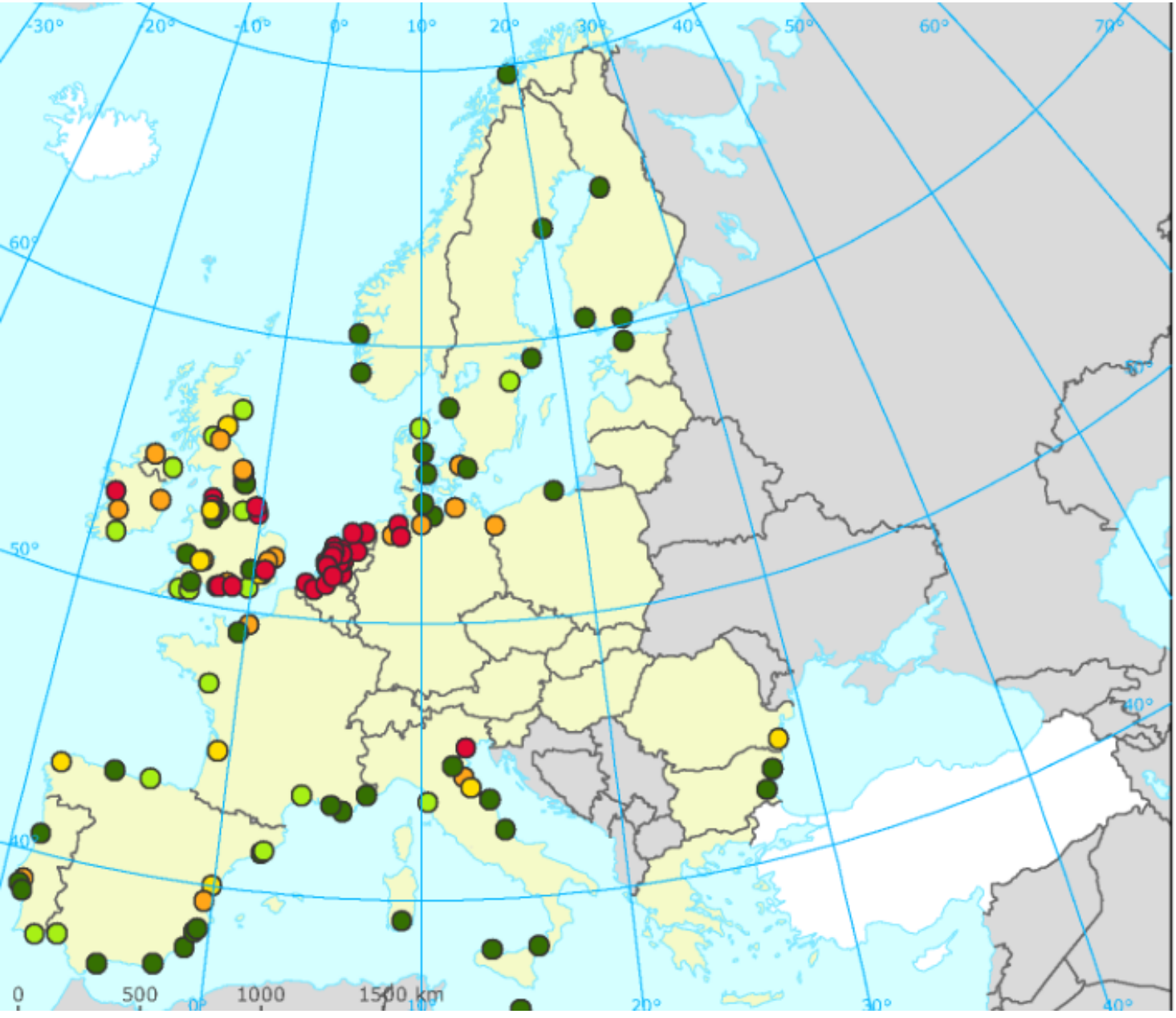


WATER SCARSITY (physical and economic)



Source: Comprehensive Assessment of Water Management in Agriculture, 2007

Increasing risk of costal flooding



Potential inundation exposure for coastal cities due to projected sea level rise and storm surge events

Urbanised area per core city affected (%)

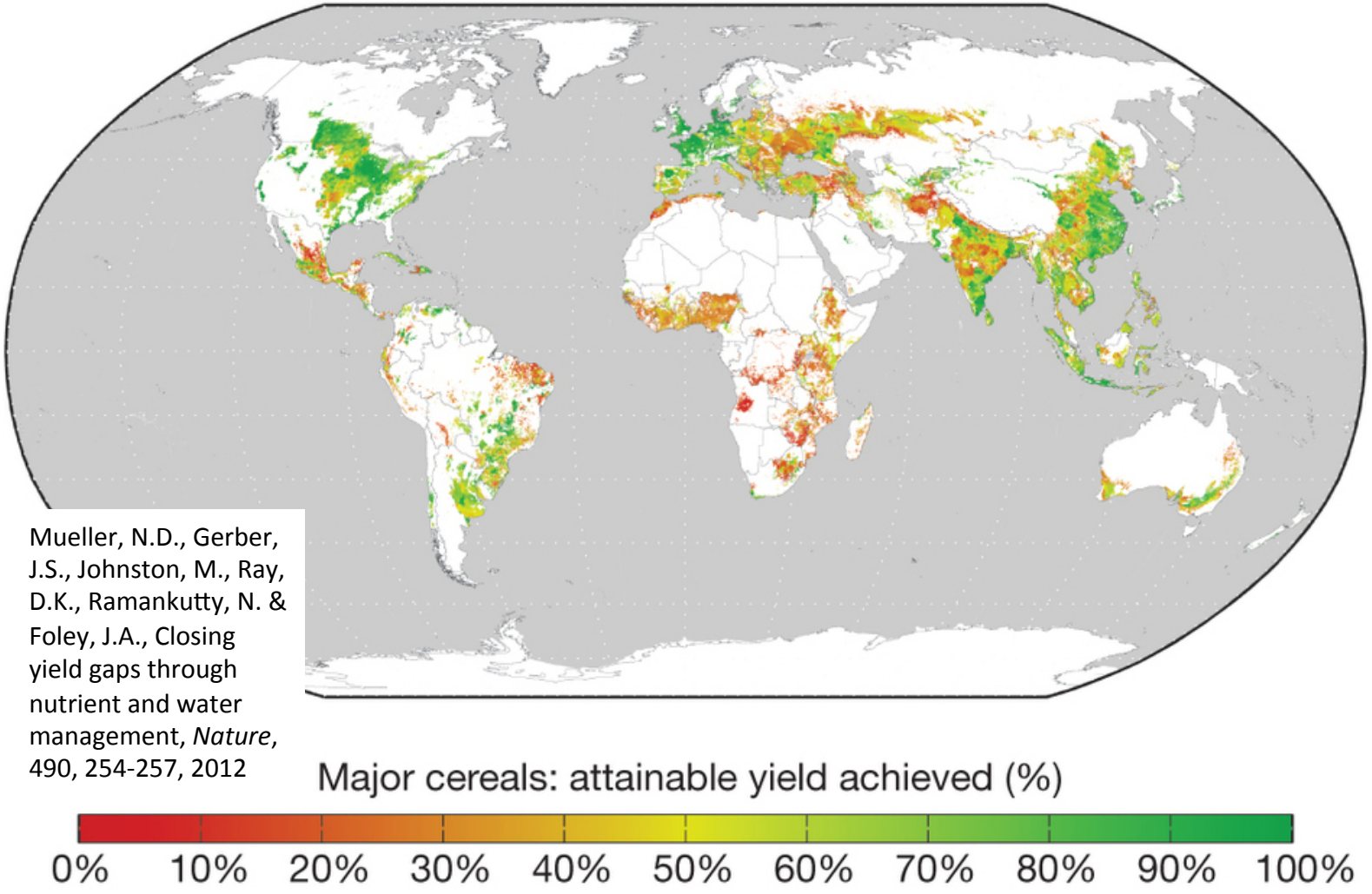
- > 0–5
- 6–10
- 11–20
- 21–40
- 41–100

No data

Outside data coverage

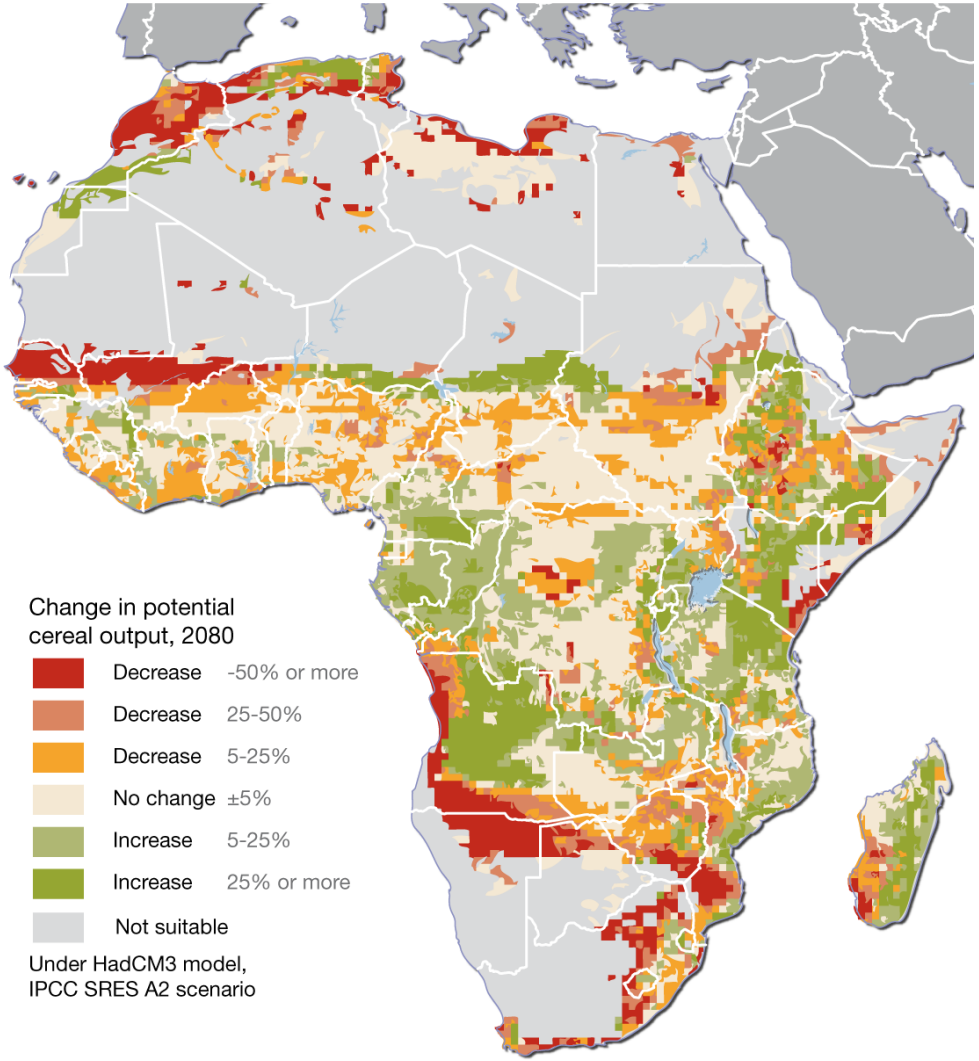
Potential increase in cereal production

Enhancing efficiency of agriculture: *yield gap closure* wher possible



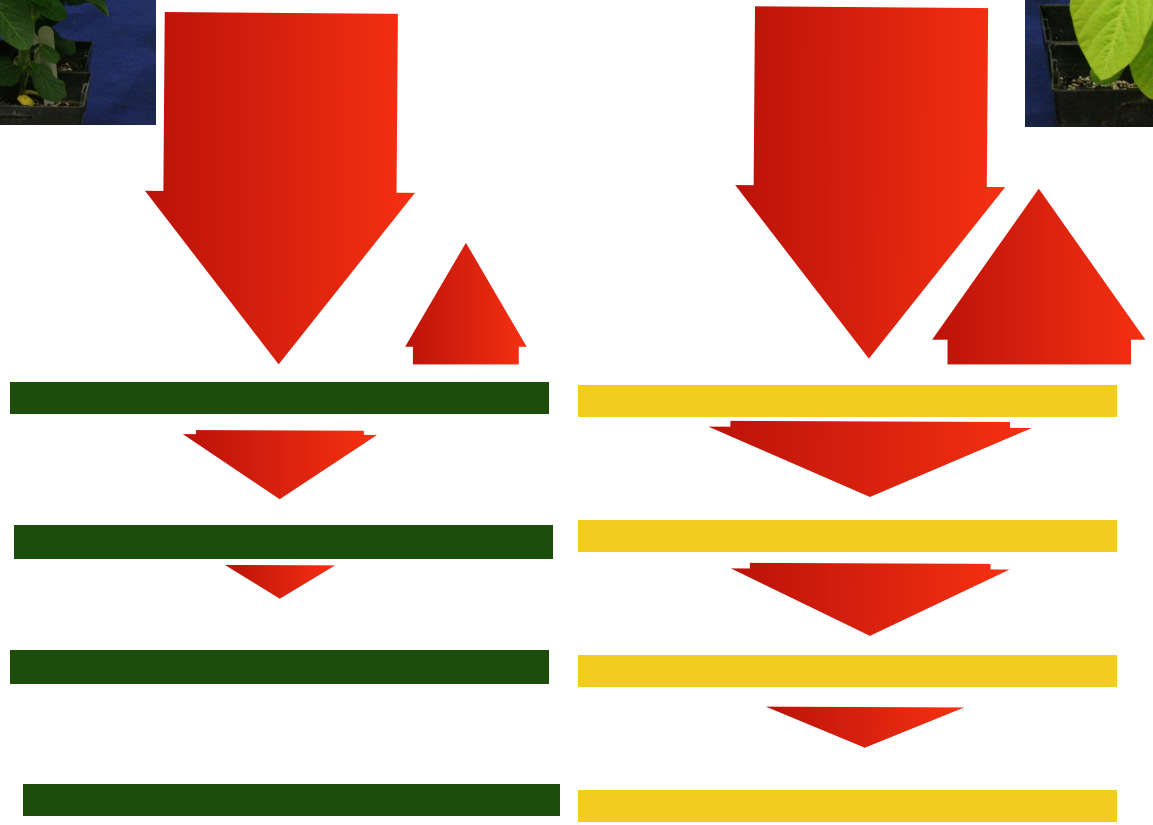
Mueller, N.D., Gerber, J.S., Johnston, M., Ray, D.K., Ramankutty, N. & Foley, J.A., Closing yield gaps through nutrient and water management, *Nature*, 490, 254-257, 2012

Climate change and predicted decrease in cereal production



Courtesy: Hugo Ahlenius, UNEP/GRID-Arendal

Geoengineering the Planet with GMO crops



Grain yield

1.22 t/ha **1.14 t/ha**

The five routes for the long term

0) Do nothing (and adapt) ← This looks risky

1) Reduce demand / increase efficiency

2) Renewable sources
- hydro
- biomass
- wind
- geothermal
- solar

This is appealing, but it's not enough

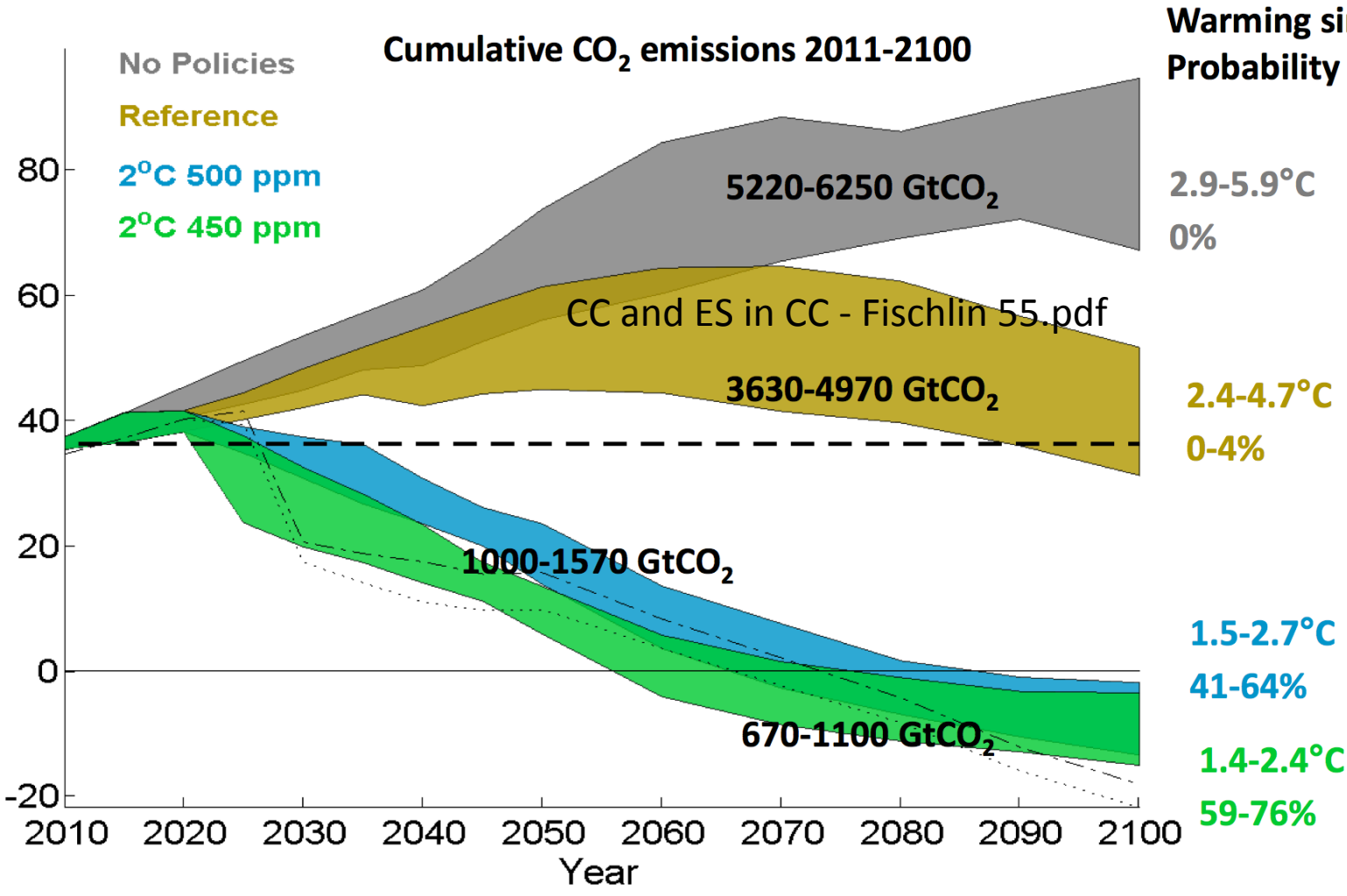
3) Nuclear
- thermal fission
- self-breeding fission
- fusion

4) CO_2 Capture and Storage (CCS)
- a the stack
- from air

One or more of these ?

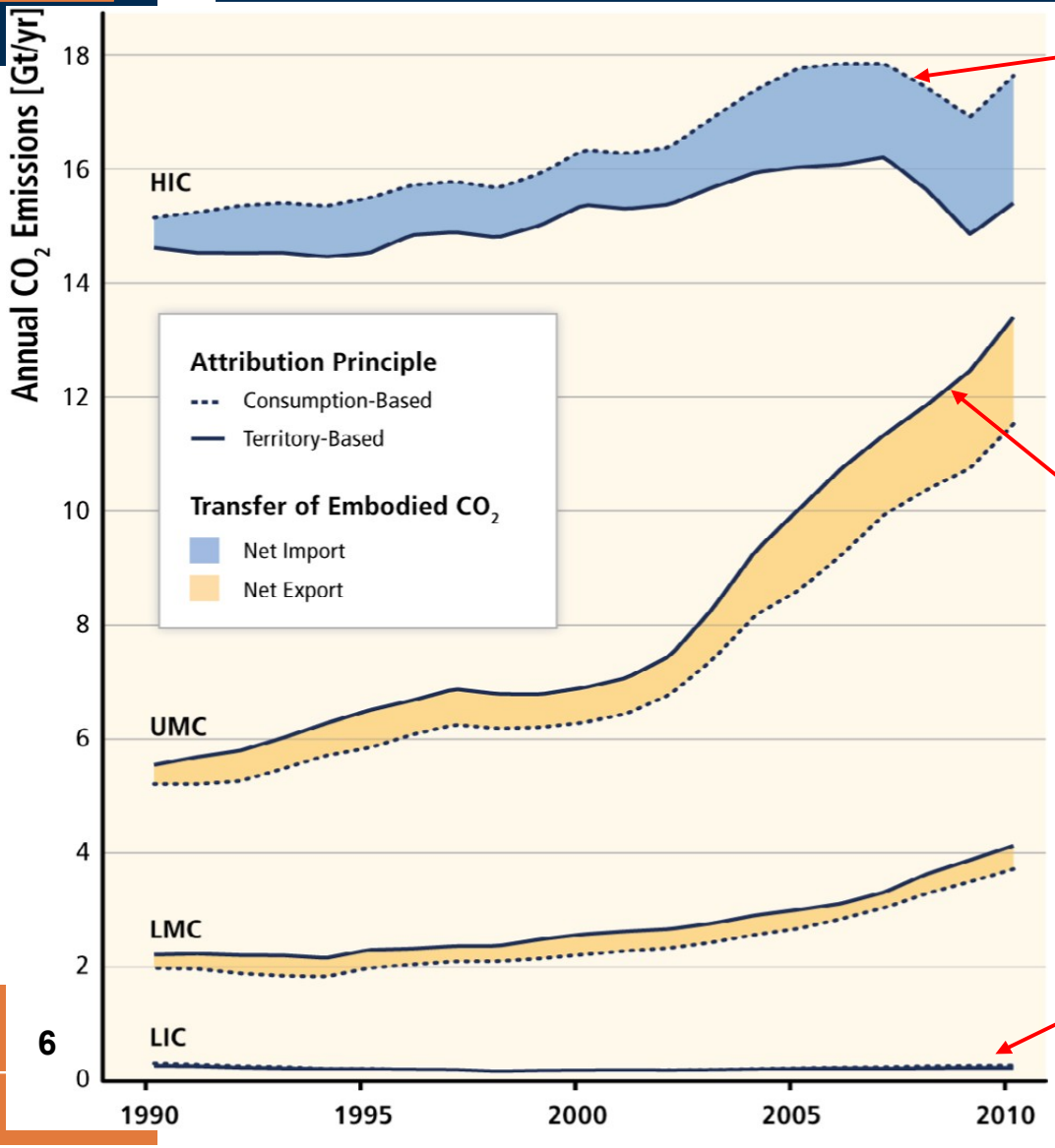
Courtesy: Stefano Consonni

Global emission pathways and carbon budgets



CC and ES in CC - Fischlin 55.pdf

Trajectory of Global CO_2 Emission by Region



High income countries
($12,616 and more)

Consumption-based CO_2 emissions do not decrease even in HIC.

Upper middle income countries
($4,086 to $12,615)
(China, Brazil, Iran, Malaysia, South Africa etc.)

Rapid increase in CO_2 emissions

Lower middle income countries
($1,036 to $4,085)
(India, Indonesia, Philippine, Egypt etc.)

Tackling poverty; low priority of CO_2 emission mitigation

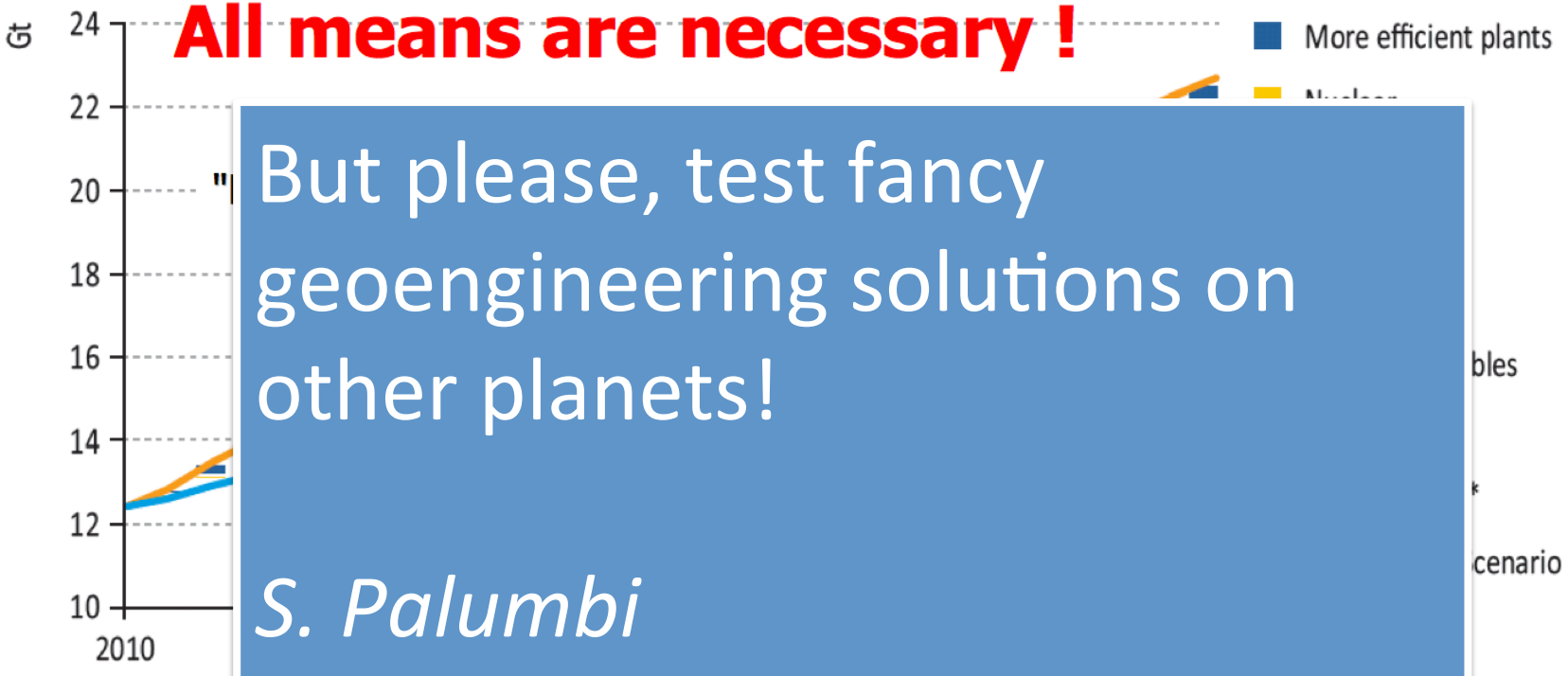
Low income countries
($1,035 and less)

Source) IPCC AR5, 2014

Final message

New Policies scenario

All means are necessary !



But please, test fancy geoengineering solutions on other planets!

S. Palumbi

*The emissions s
electricity genera
thermal generating plants after 2009.

Source: World Energy Outlook 2011, International Energy Agency

Courtesy: Stefano Consonni

Impacts of Climate Change on Ecosystem Services

Wrap-up

Alessandro Cescatti

Joint Research Centre, European Commission
Institute for the Environment and Sustainability
Climate Risk Management Unit

Politecnico di Milano *23 June, 2015*

text

text

text

text

text