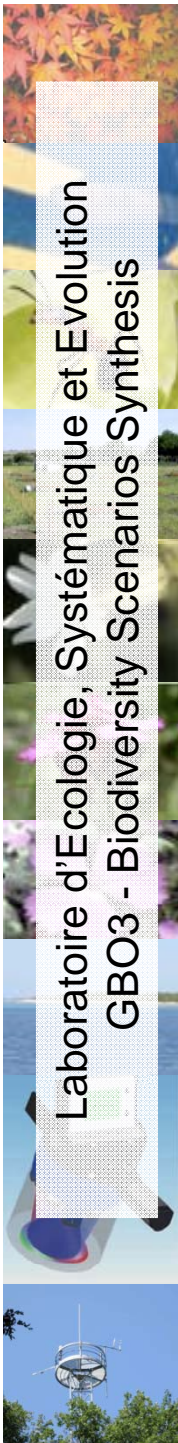


CBD - Global Biodiversity Outlook 3 Scenarios Synthesis

A synthesis and assessment of projections of 21st century changes in biodiversity and associated ecosystem services based on an analysis of a broad range of existing models, experiments and observations

Paul Leadley, Université Paris-Sud 11





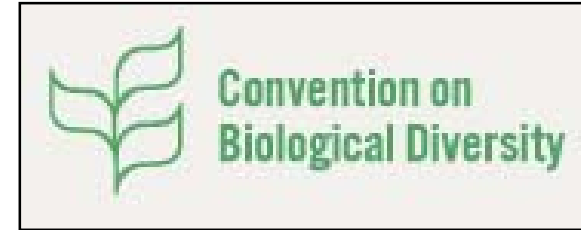
CBD - Global Biodiversity Outlook 3 - Scenarios

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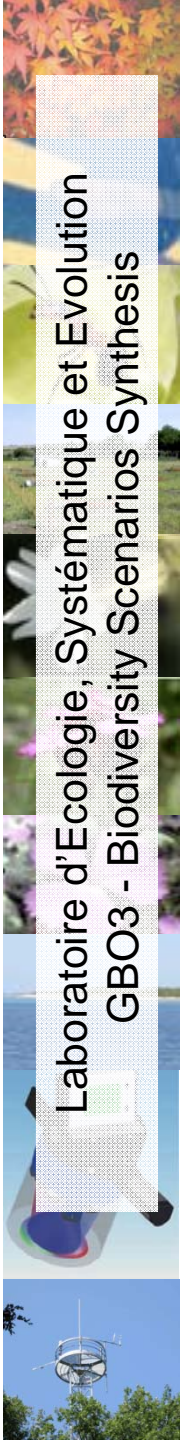


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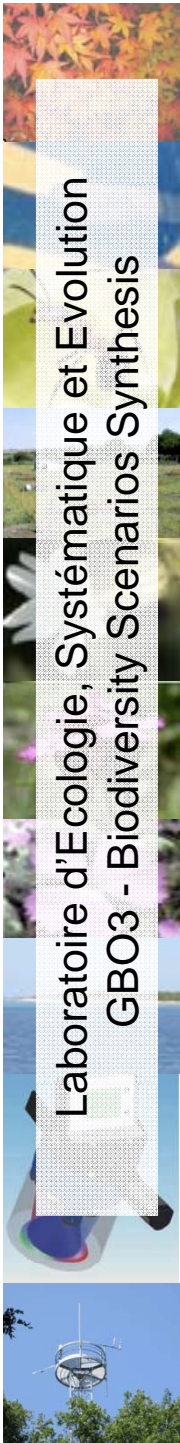
Global Biodiversity Outlook 3 - Scenarios

Key conclusions (Impacts):

- Projections of the impact of global change of biodiversity show continuing and often accelerating species extinctions, loss of natural habitat, and changes in the distribution and abundance of species, species groups and biomes over the 21st century.
- There are widespread thresholds, amplifying feedbacks and time-lagged effects leading to “tipping points”, or abrupt shifts in the state of ecosystems. This makes the impacts of global change on biodiversity hard to predict, difficult to control once they begin, and slow and expensive to reverse once they have occurred.
- There are several important examples in which widespread biodiversity loss is projected to result in degradation of the services provided to human societies by ecosystems.

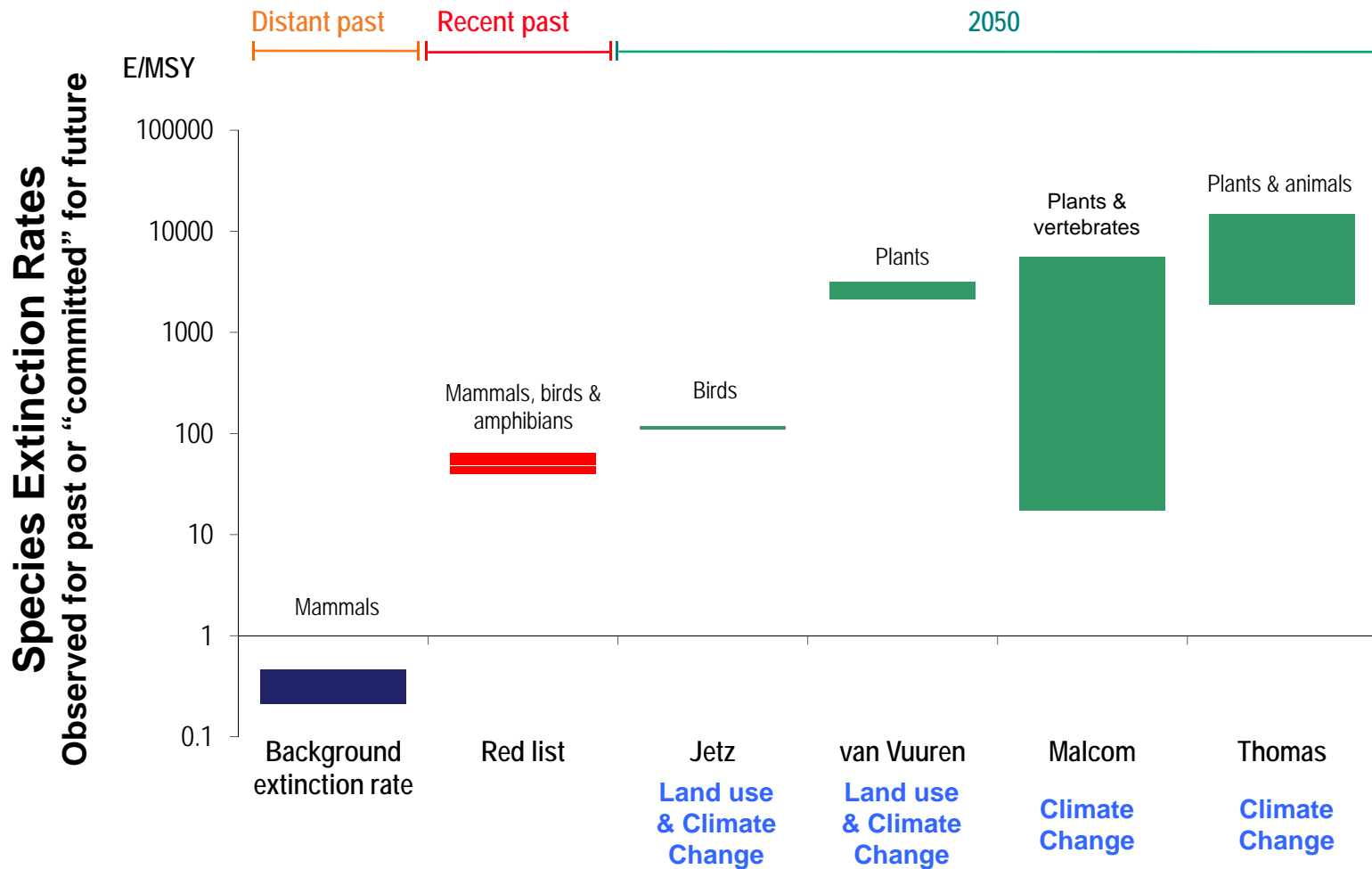


Species Extinctions



GBO3 – Terrestrial Scenarios

Projected Terrestrial Species Extinctions



There are large uncertainties in projections of species extinctions.

High projected rates of extinction due to climate change are not coherent with observed rates of extinctions in the past.

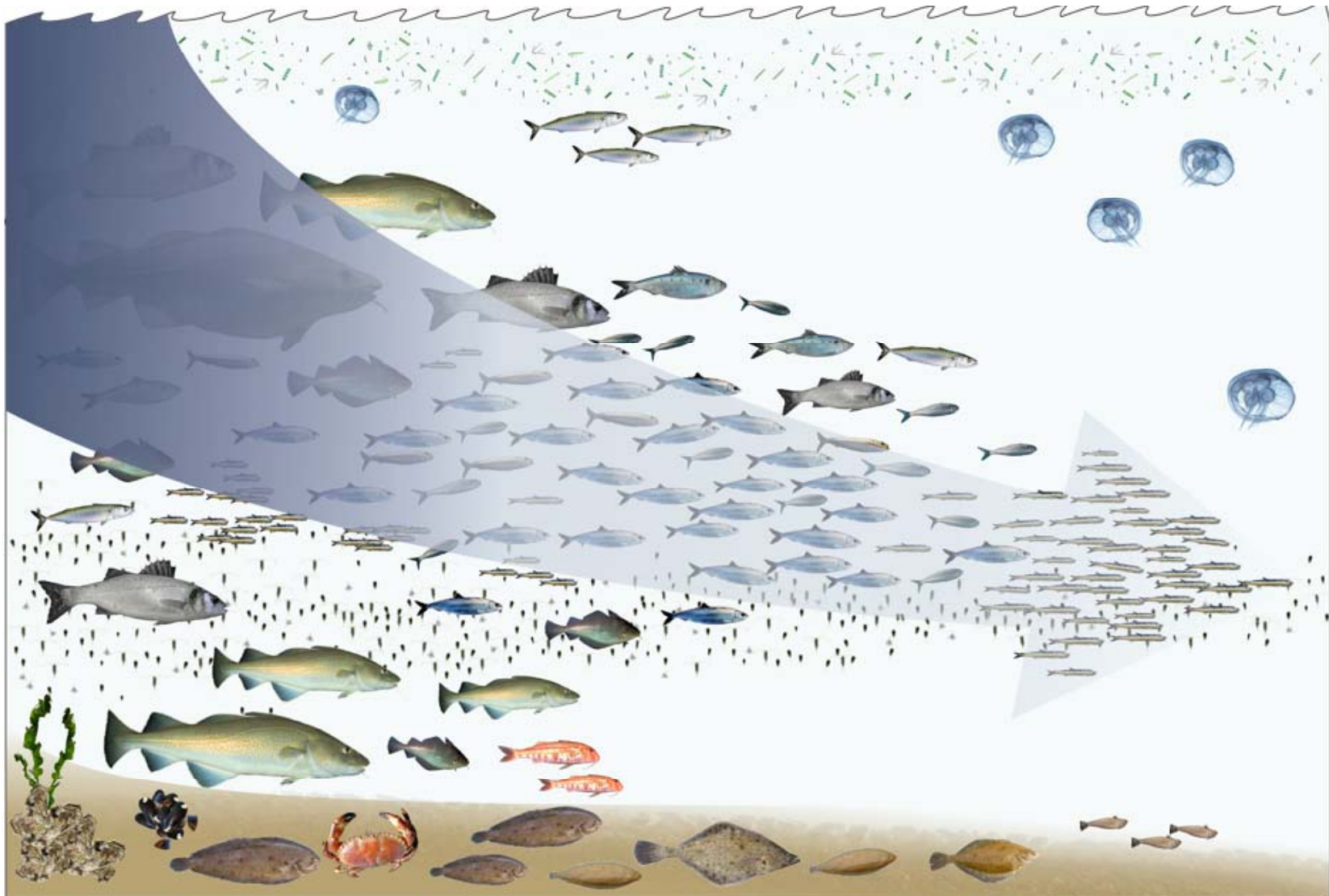
A much stronger, transparent dialog between scientists, managers and policy makers concerning uncertainty is essential.

The very real risks of high extinction rates argues in favor of a strong precautionary approach.

Changes in species abundance

GBO3 – Marine Scenarios

“Fishing down the food web”

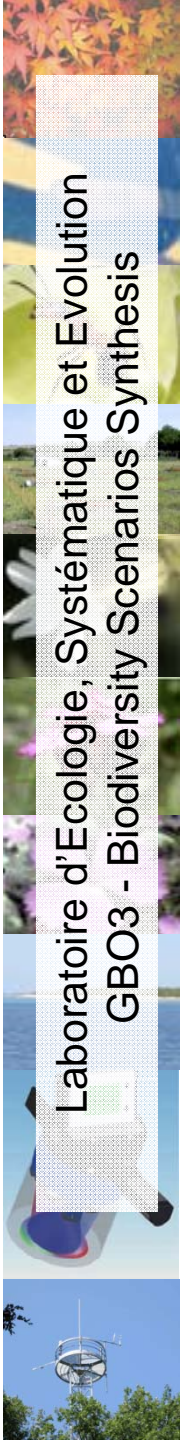


GBO3 – Marine Scenarios

Scenarios for Marine Fisheries

Small reduction in catch
compared to BAU 

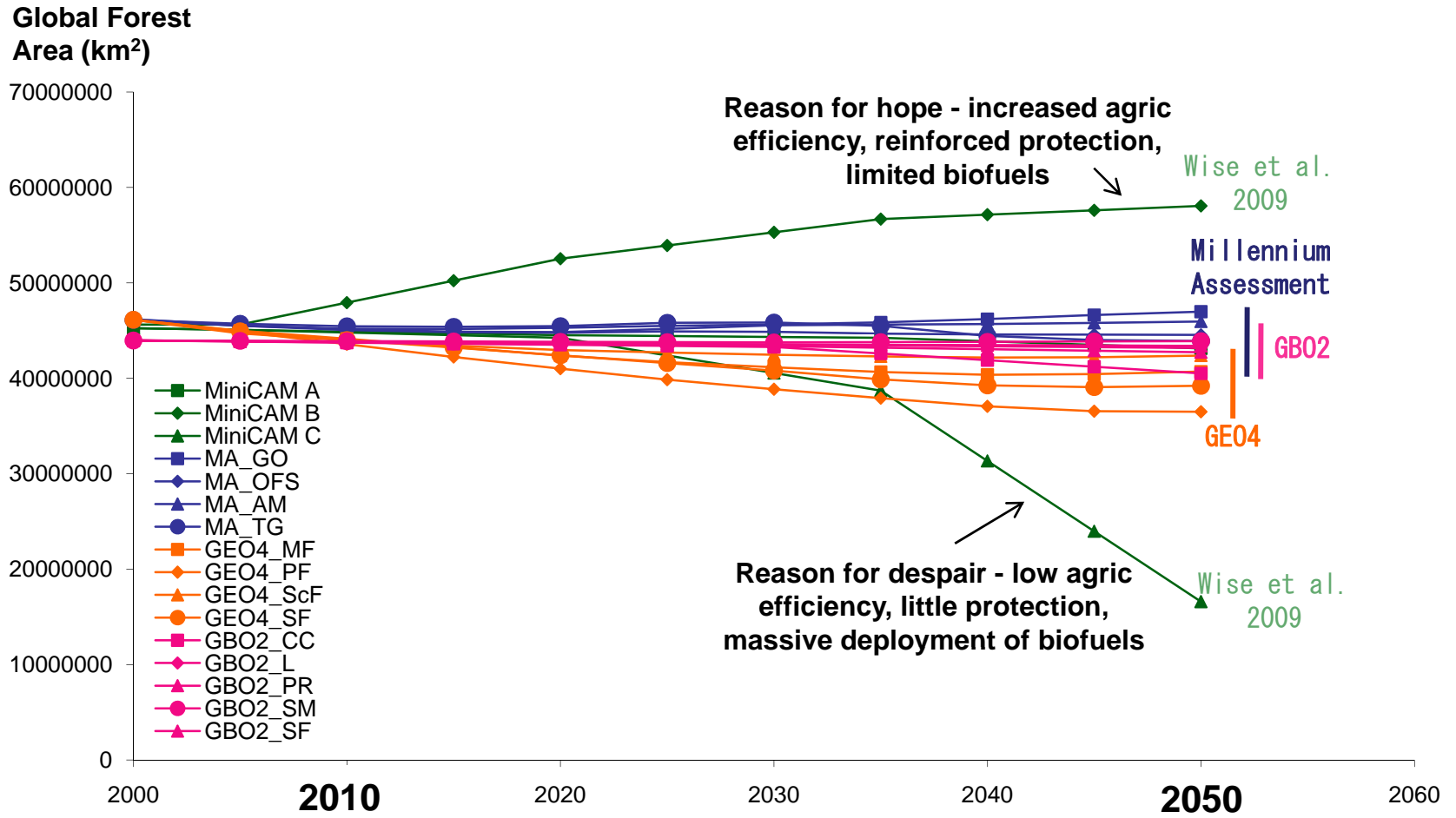

“Business as usual (BAU)”



Habitat Loss

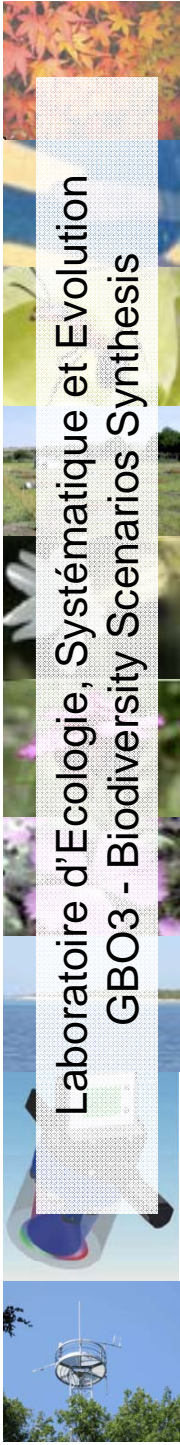
GBO3 – Terrestrial Scenarios

Projected Terrestrial Habitat Loss



Ambitious goals for reducing the rate of destruction of natural habitats will be very difficult to achieve, but are possible

Poor global, national and local decision making can contribute to catastrophic habitat conversion rates



Shifts in the distribution of species and biomes



High global warming



Green = shrub or tree cover gain



Low global warming

The Arctic Biome Shift

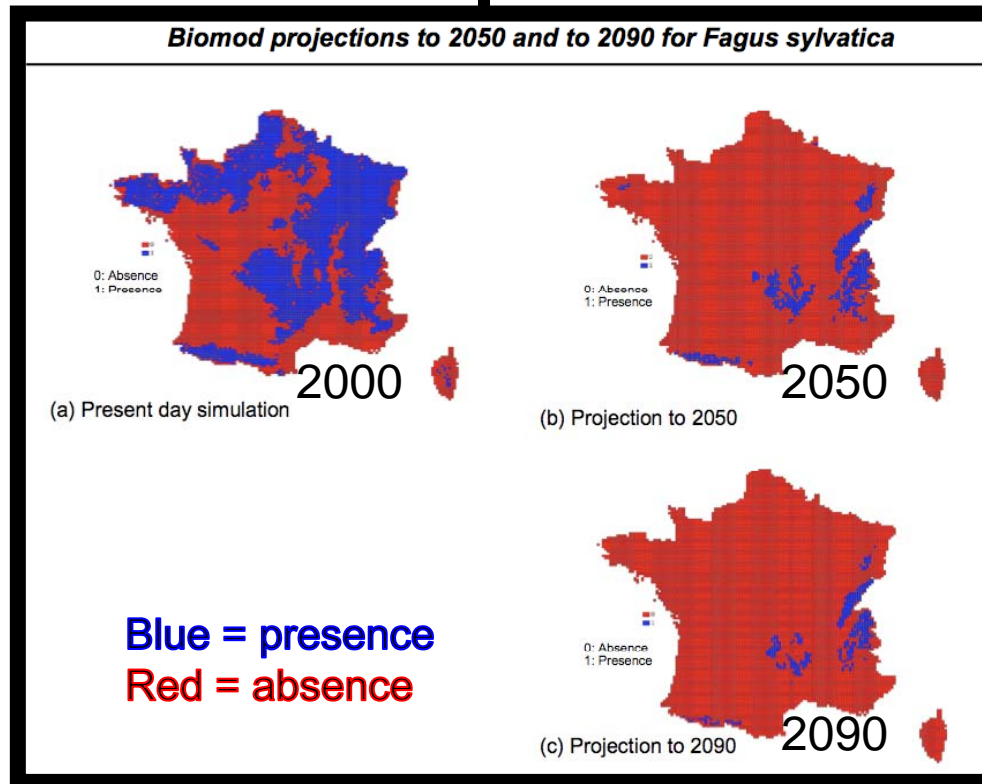
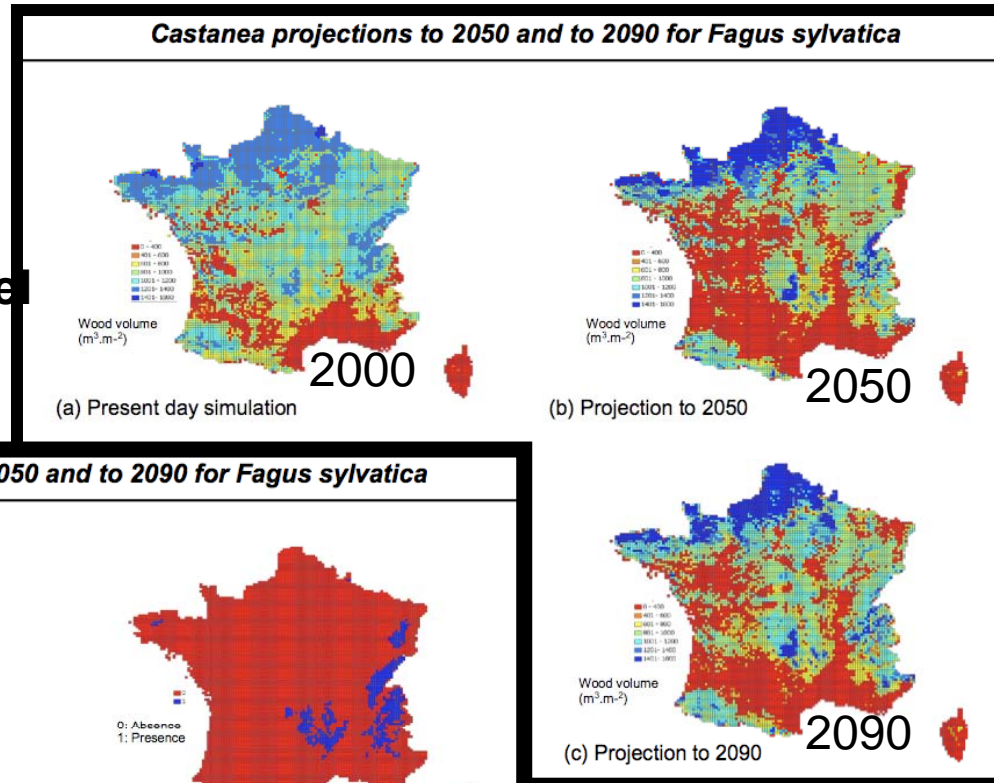
- Large biome shifts are "very likely" to occur
- Aggressive climate mitigation substantially reduces species and biome range shifts

Figure: LPJ global vegetation model projections for 2100 from IPCC (2007)

Shifts in species distributions are likely to be large

Climate change impacts on European beech

Niche-based model
BIOMOD
W. Thuiller ↓



↑ Mechanistic tree growth model
CASTANEA
A Cheaib,
C François,
E Dufrêne

Projected shifts in species and biome shifts are qualitatively coherent with observed shifts in the paleological record and current observations

Large shifts in species and biome distributions are “very likely” to be inevitable due to climate change and other drivers.

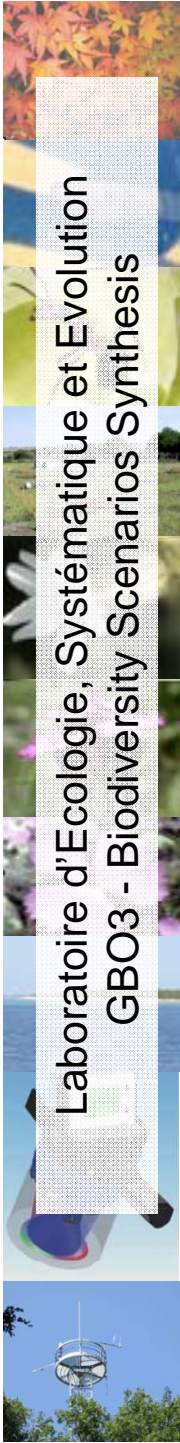
Ambitious climate mitigation is a biodiversity imperative

Many of the largest impacts of future biodiversity change on ecosystem services will arise from these shifts

GBO3 – Tipping Points

Tipping points have important impacts on biodiversity and ecosystem services at regional to global scales, and occur due several processes:

- 1) The overall effect of a global change driver is amplified by feedbacks;**
- 2) There is a threshold beyond which an abrupt shift between alternate ecological stable states occurs;**
- 3) The changes induced by the driver are hard to reverse;**
- 4) There is a significant time lag between the dynamics of the drivers and the expression of impacts, causing great difficulties in ecological management.**

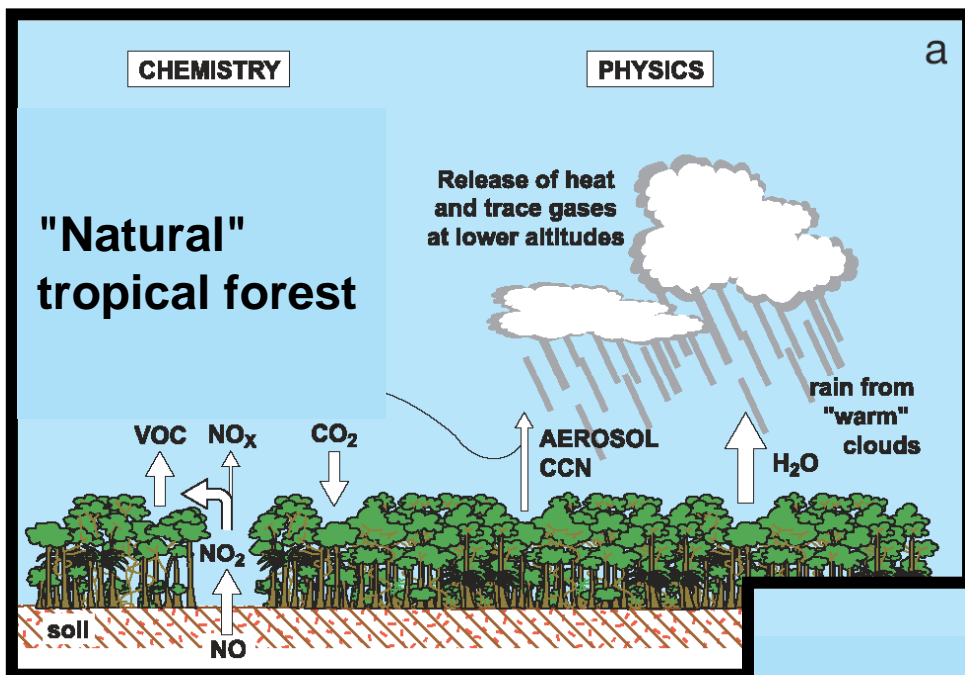


Global Biodiversity Outlook 3

A map of key biodiversity tipping points

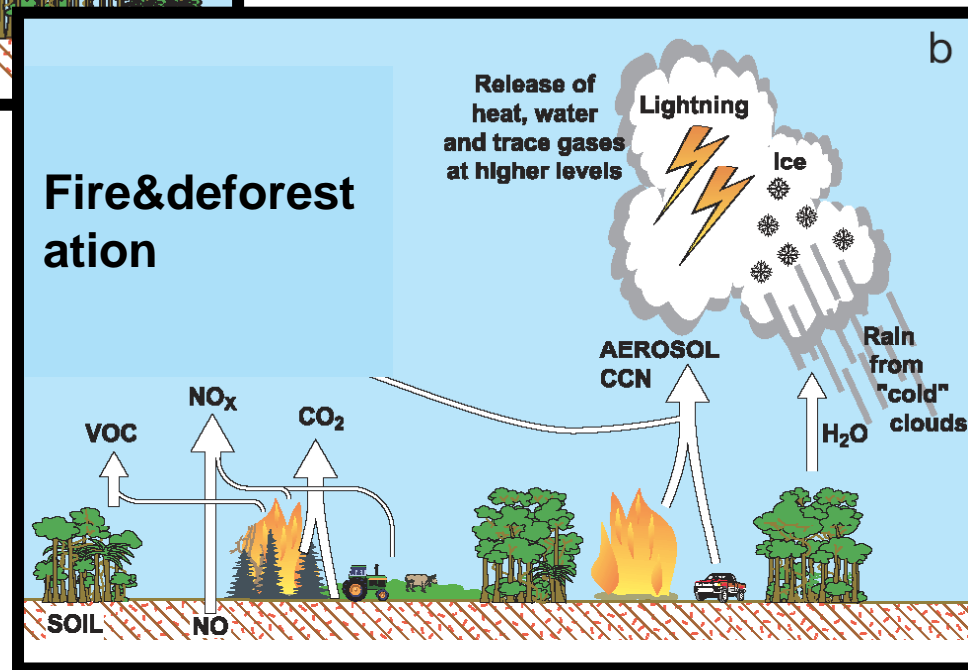
Amazon forest tipping-point: fire and deforestation

Laboratoire d'Ecologie, Systématique et Evolution
 GBO3 - Biodiversity Scenarios Synthesis



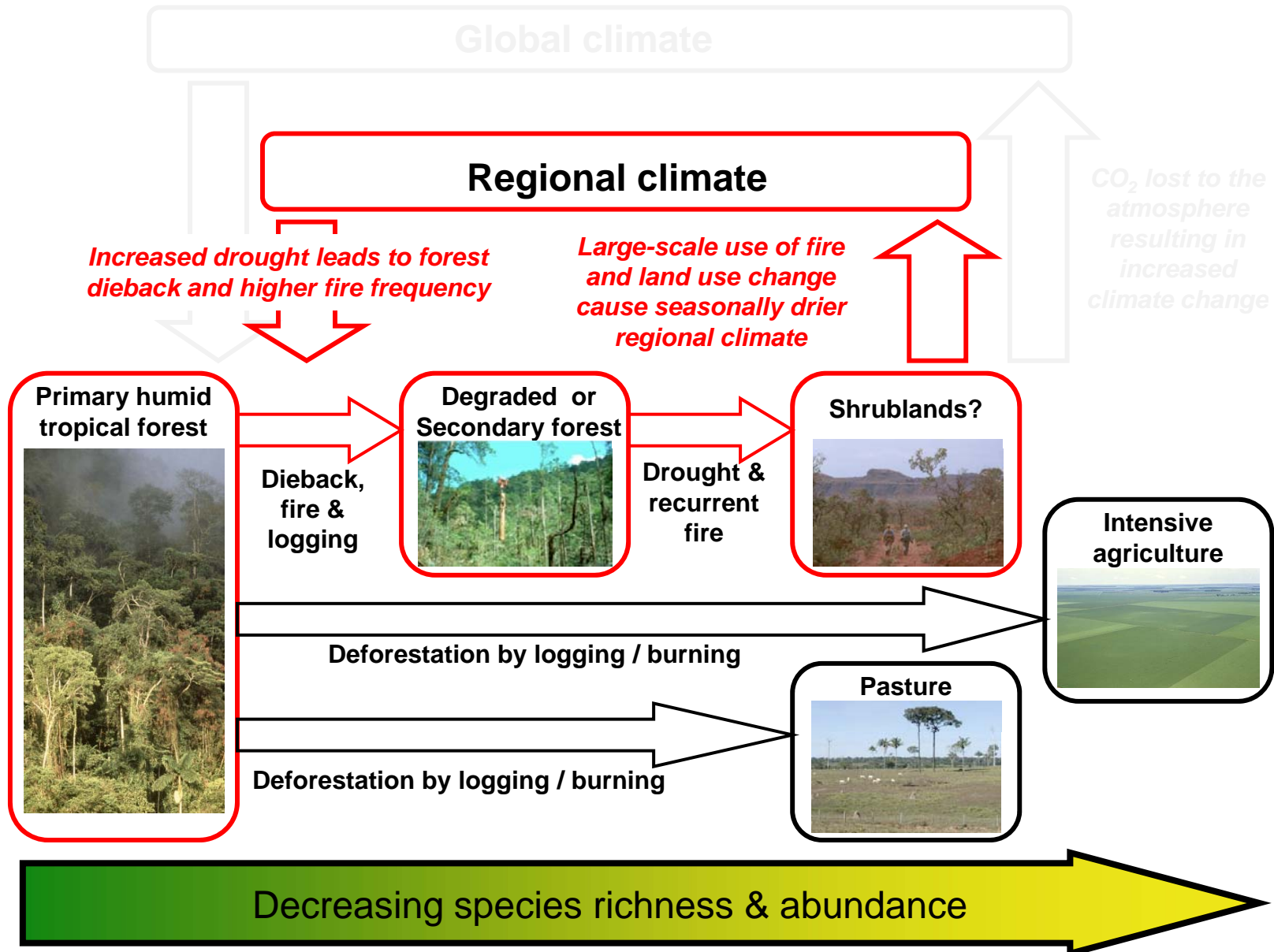
Short, heavy episodes of rainfall & "Dry season" rainfall reduced

"Gentle" rainfall that is relatively uniform over the season

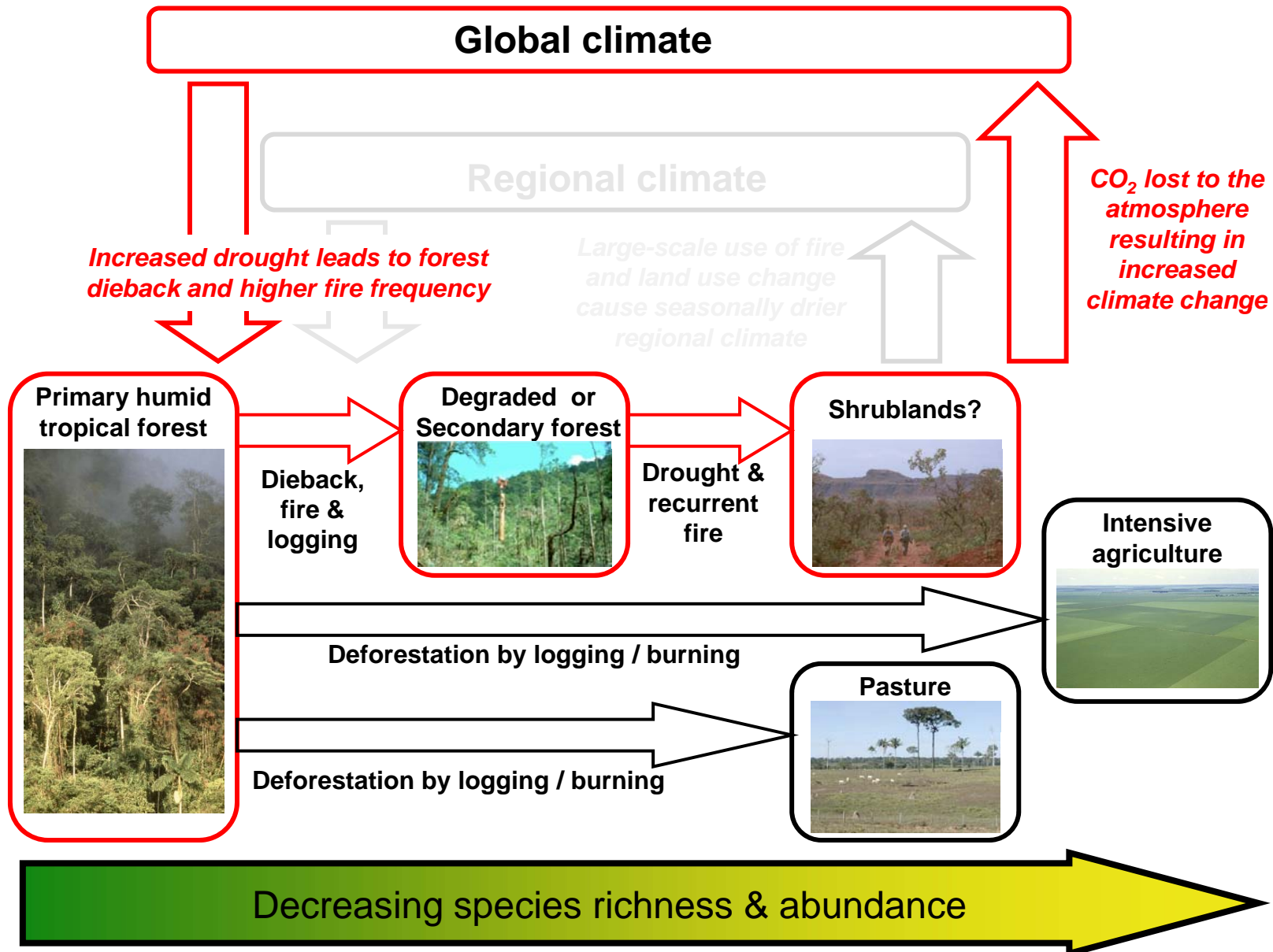


iLEAPS science plan (from Andreae)

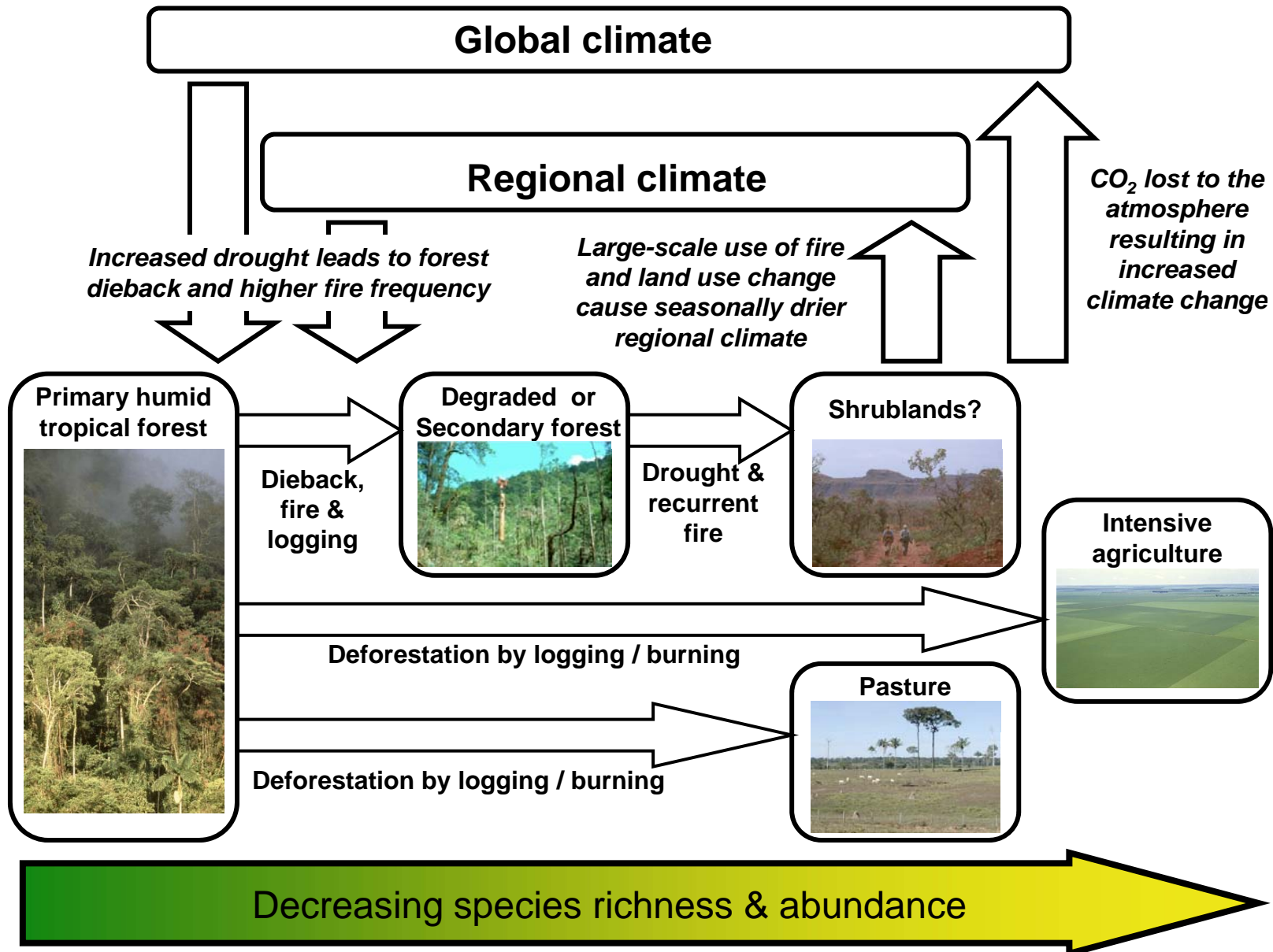
Amazon forest tipping-point: fire & deforestation



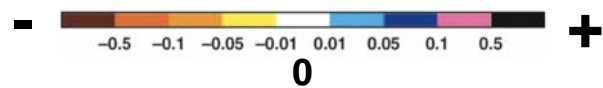
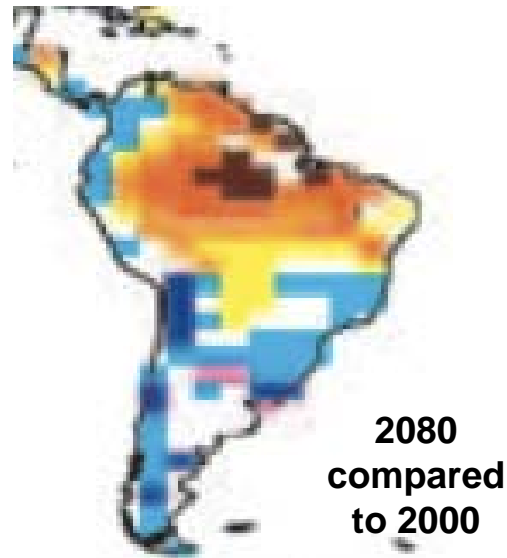
Amazon forest tipping-point: global climate change



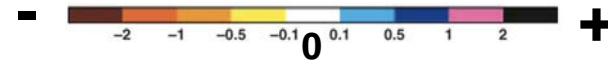
Amazon forest tipping-point: regional & global drivers



Amazon forest tipping point



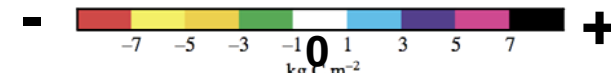
Change in humid tropical forest (fraction of current)



Change in precipitation (mm / day)



Betts et al.
2004



Change in C storage (kg C / m²)

Global Biodiversity Outlook 3 *Amazon forest tipping-point*

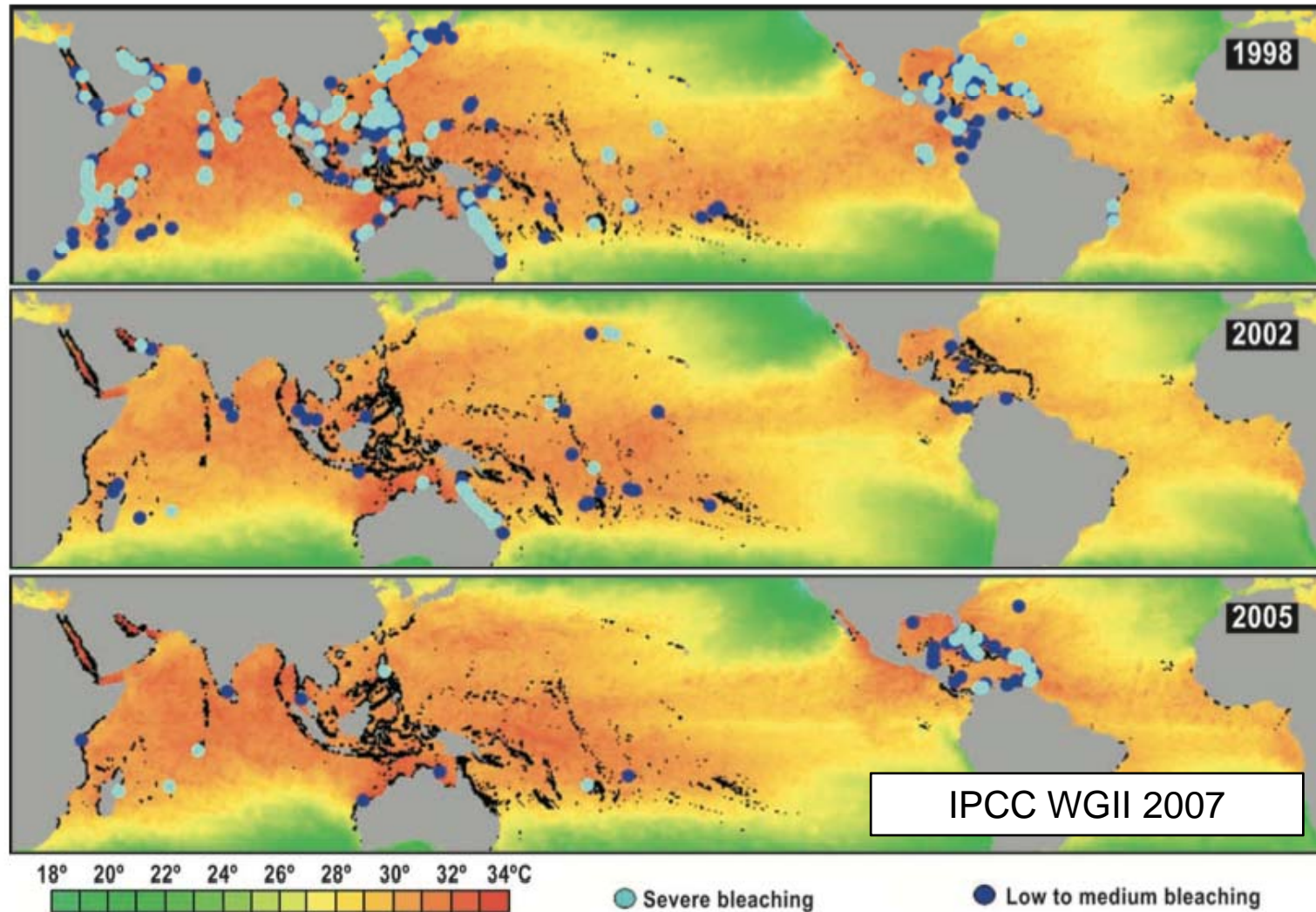
Modeling studies suggest that deforestation beyond ca. 20-40% and climate change of more than 2-4°C could lead to widespread humid tropical forest dieback

This would have extremely large impacts on biodiversity, regional rainfall and global C cycles

Large uncertainties remain, particularly related to the adaptive capacity of humid tropical forests to drought

Global Warming and Coral Reefs

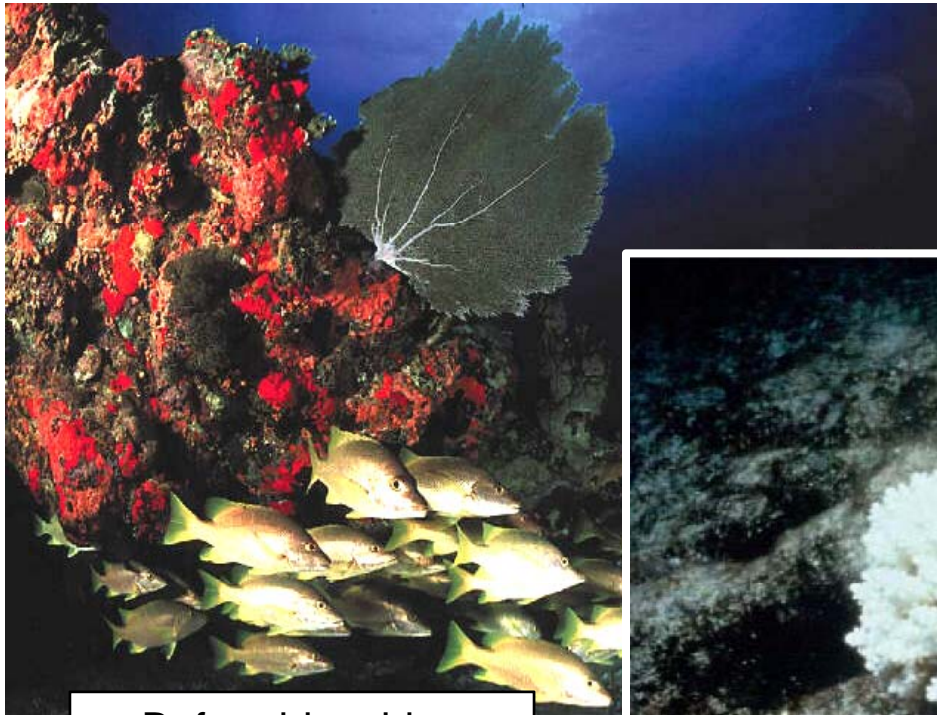
Climate warming is already having widespread negative impacts on coral reefs



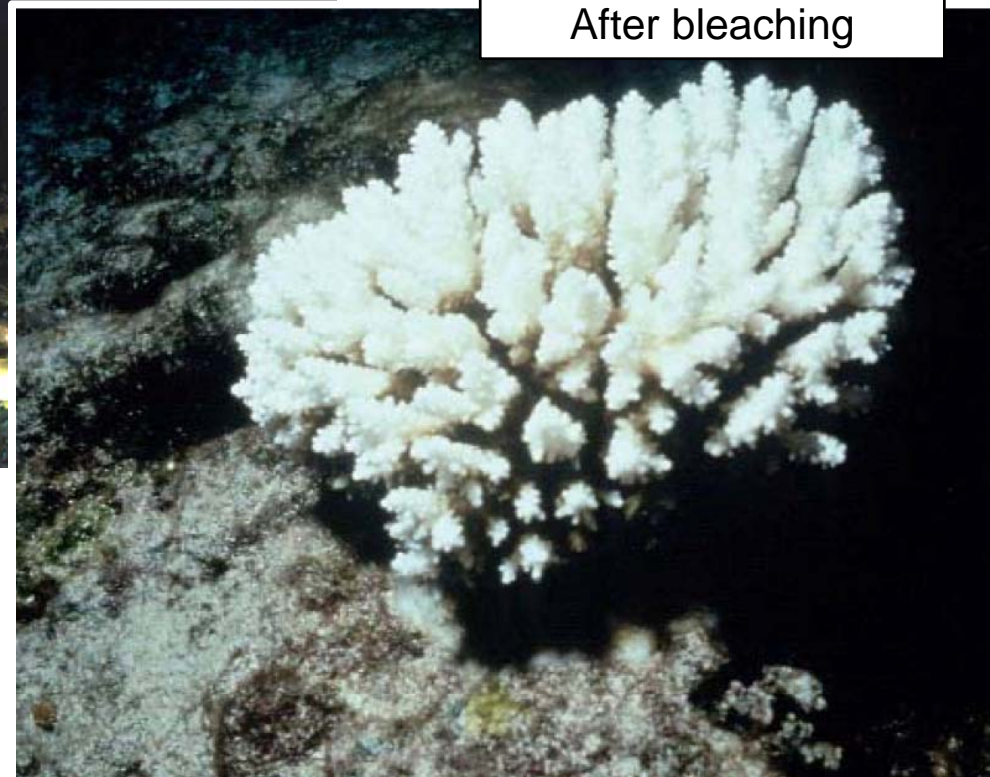
Maximum monthly mean sea surface temperature for 1998, 2002 and 2005, and locations of reported coral bleaching (data sources: NOAA CoralReef Watch (<http://coralreefwatch.noaa.gov/>) and Reefbase (<http://www.reefbase.org/>)).

Global Warming and Coral Reefs

Climate warming is already having widespread negative impacts on coral reefs



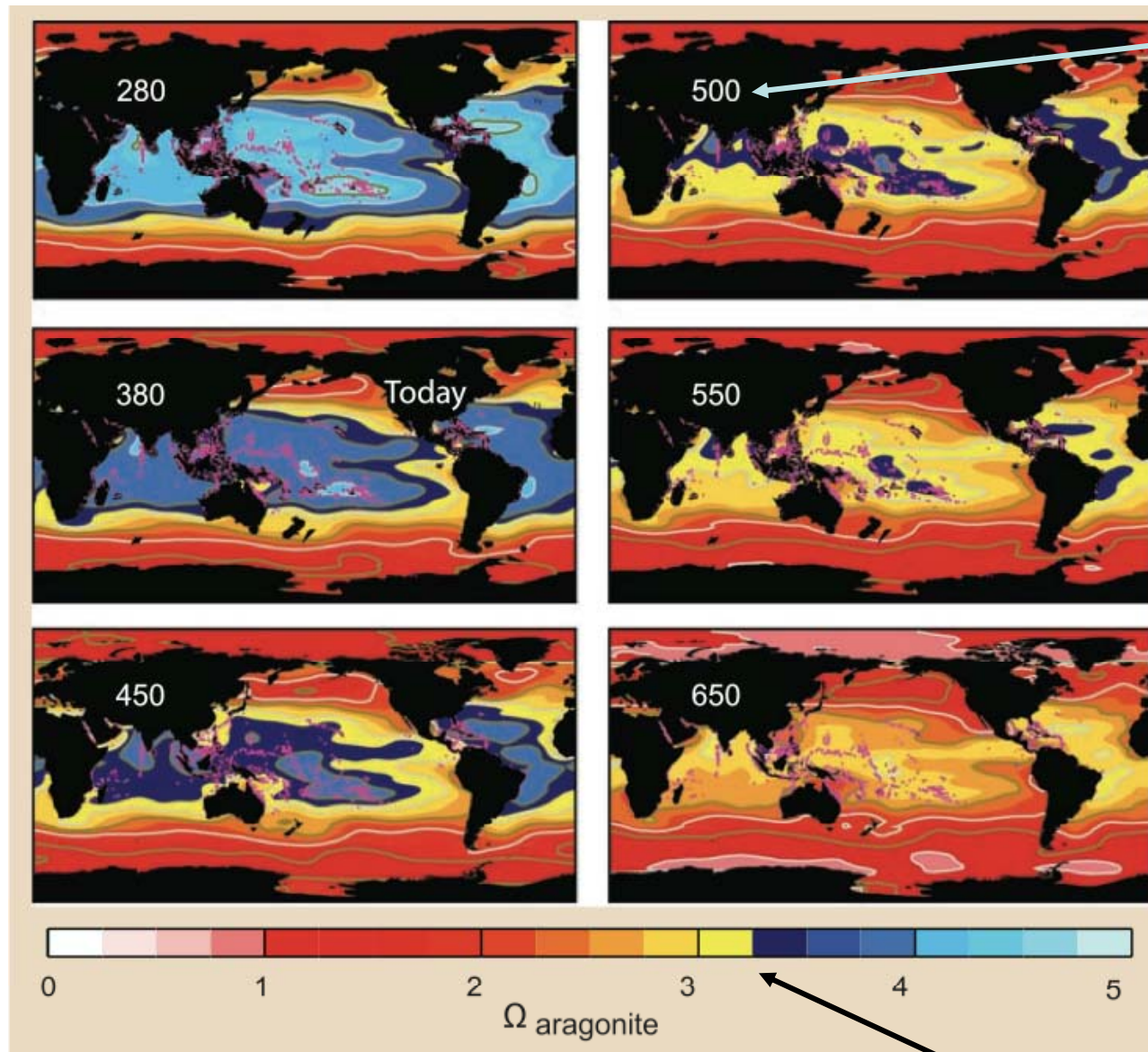
Before bleaching



After bleaching

Ocean Acidification and Coral Reefs

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GBO3 - Biodiversity Scenarios Synthesis



Atmospheric CO₂ concentration

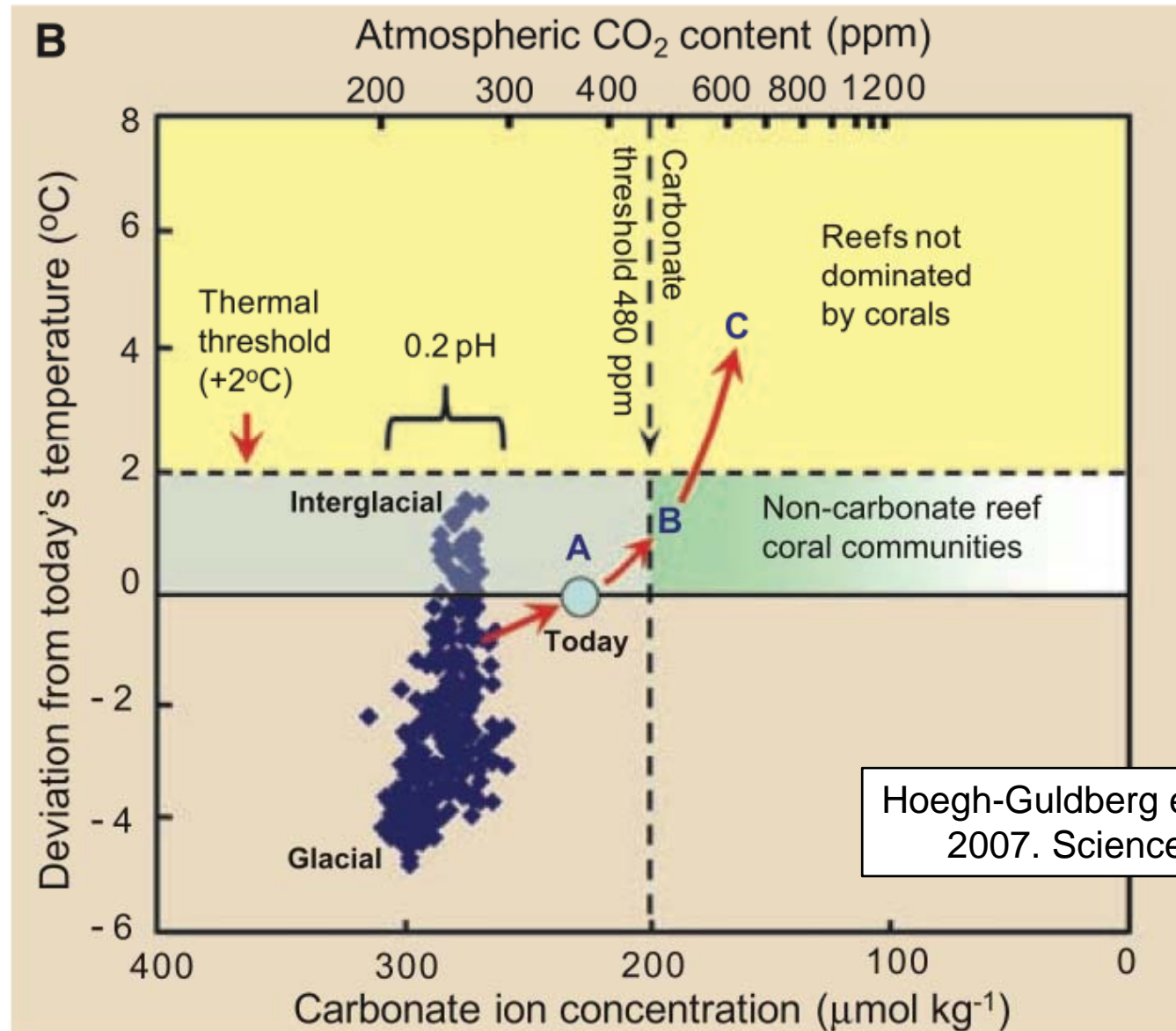
Models of ocean chemistry suggest that hard corals will be unable to build reefs (aragonite) due to ocean acidification by the middle of the 21st Century

Hoegh-Guldberg et al. 2007 Science

Level below which hard corals cannot build reefs

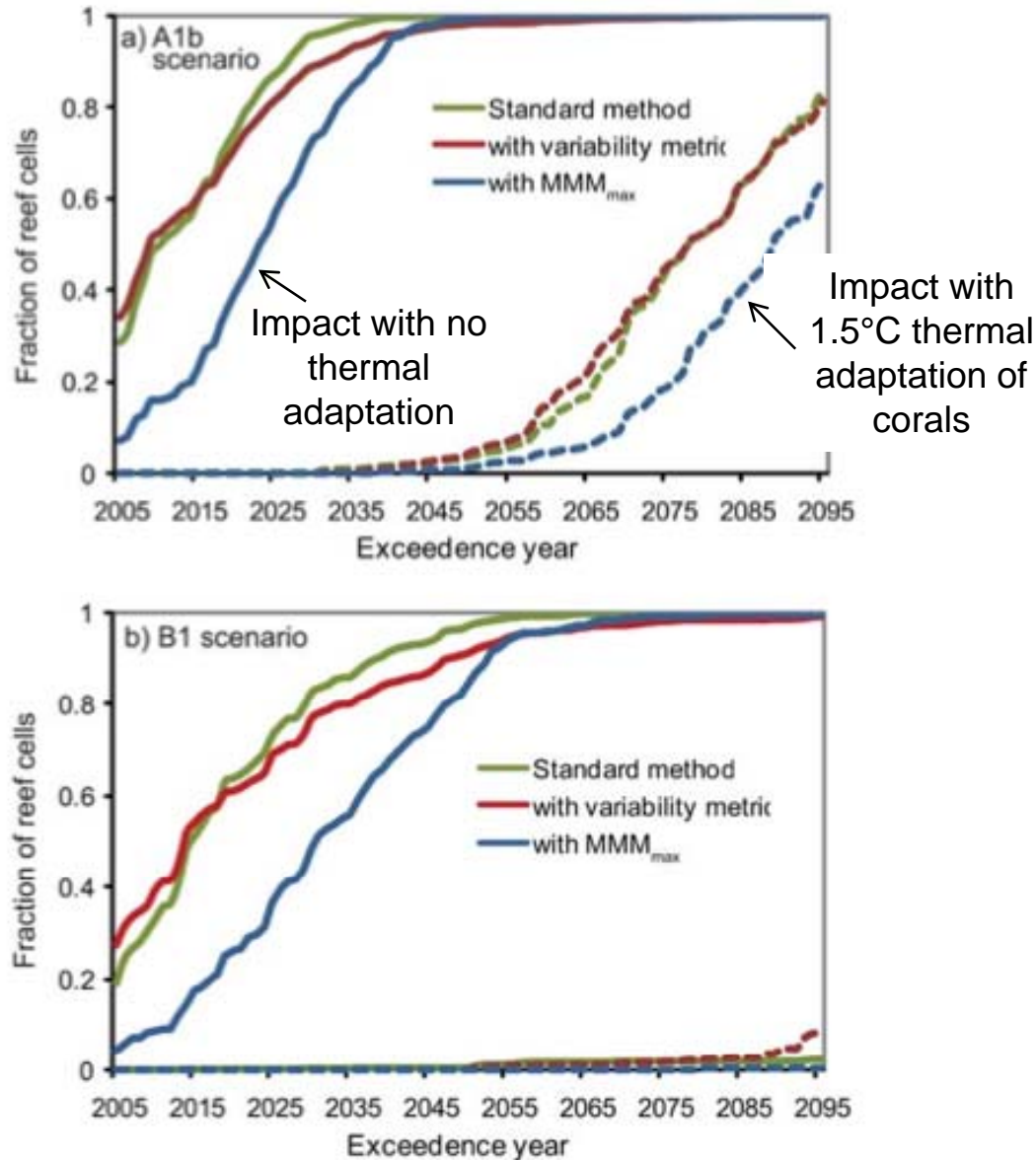
Global Change and Coral Reefs

A long-term perspective on temperature and ocean acidification



Glimmers of Hope

Fraction of coral reefs with severe bleaching

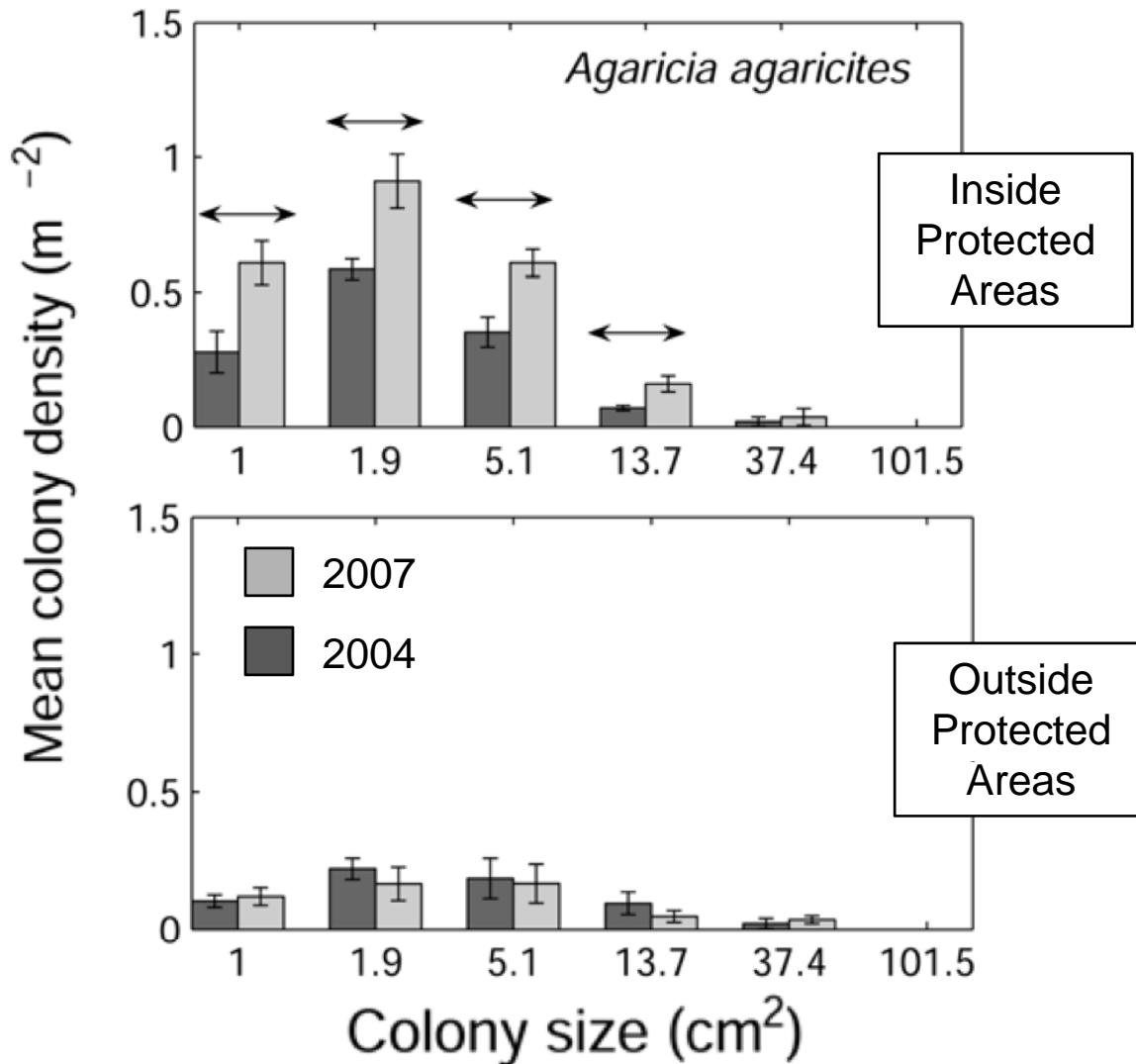


Biologically realistic rates of adaptation may allow coral reefs to adapt to thermal stress, if the rise in sea surface temperatures is significantly slowed

Donner. 2009.
 PLoS ONE

Glimmers of Hope

Marine Protected Areas may substantially increase the resistance and resilience of Coral Reefs



Marine reserves in the Bahamas improve recovery of hard corals from a severe bleaching event (1998)

Mumby & Harborne. 2010. PLoS ONE

GBO3 – Measures to protect biodiversity

“Biodiversity transformations could be significantly reduced or even reversed if strong action is applied urgently, comprehensively and appropriately, at international, national and local levels. This action must focus on addressing the direct and indirect factors driving biodiversity loss, and must adapt to changing knowledge and conditions”

GBO3 – Measures to protect biodiversity

- **Protection of biodiversity is intimately tied to human development goals.** Education, good governance, poverty alleviation, etc. show up in many tipping points as the key to protecting biodiversity.

- **We must reduce the pressure of direct drivers on biodiversity**

Land use - Limited biofuels deployment and major improvements in agricultural efficiency, forestry practices and land use planning are required to protect biodiversity.

Climate change - Very ambitious climate mitigation is essential for minimizing species and habitat loss and shifts in the distribution of species and biomes.

- **Protected areas on land and sea will remain a key to minimizing biodiversity loss**

Protected areas on land are increasing in area and this trend should be continued

Substantially increasing marine protected areas are a top priority