Biodiversity - climate interactions: a science perspective

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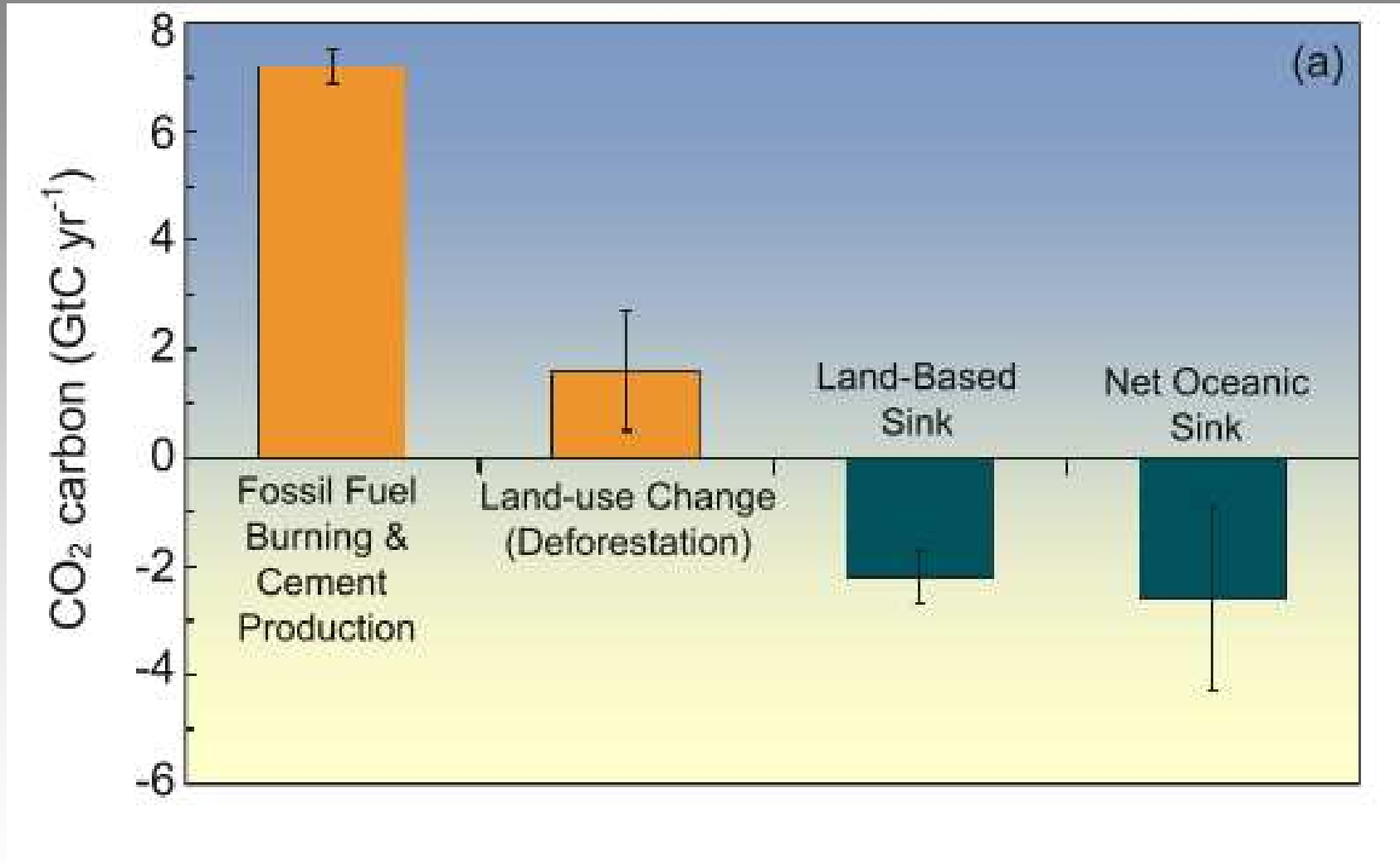
Biodiversity-climate interactions: overview

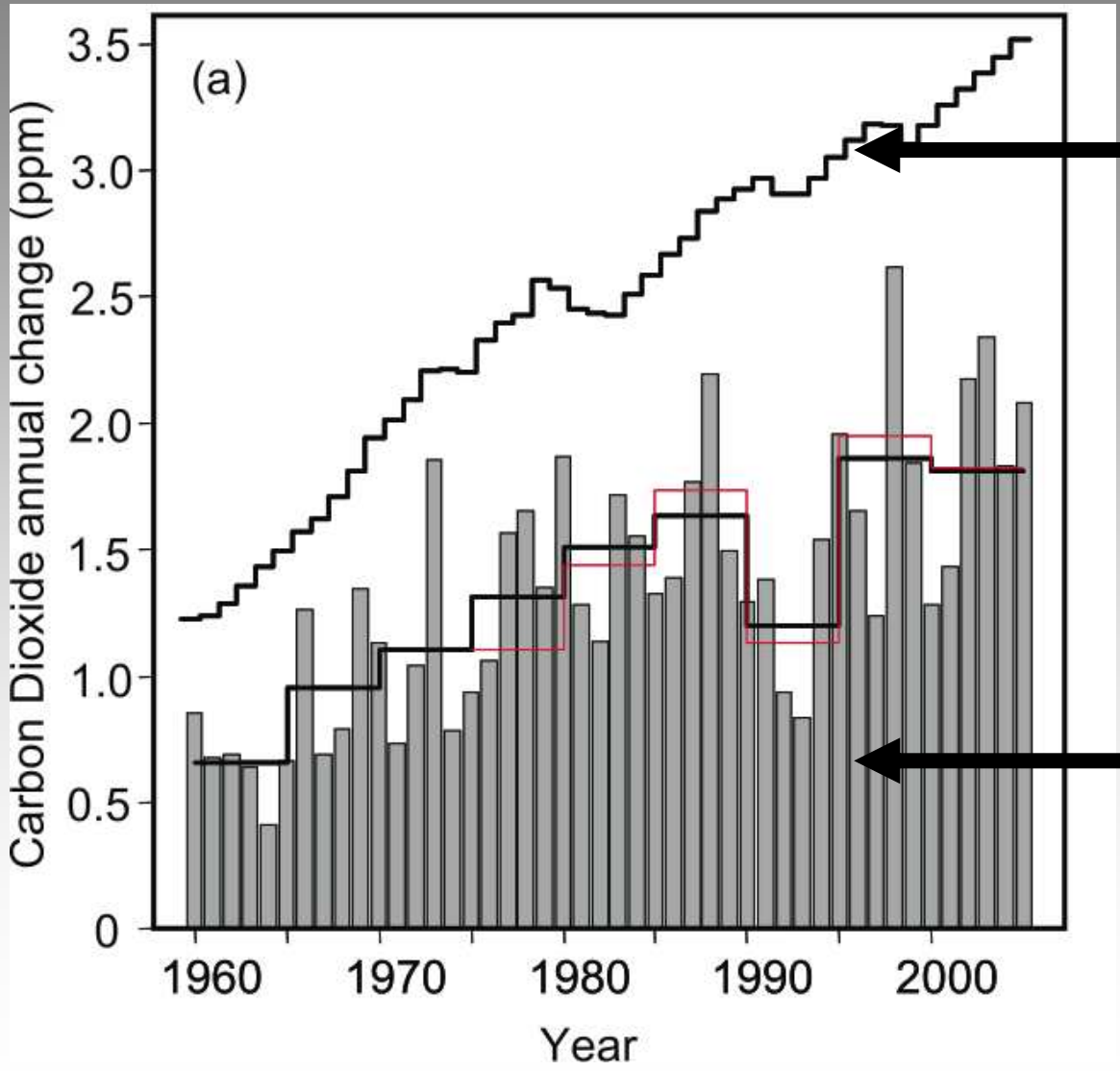
- Importance of ecosystems in the climate system
- Carbon emissions and uptake
- Beyond carbon
  - added value of other ecosystem services
- Biodiversity and ecosystem functioning
- Synergies between maintaining biodiversity and climate change mitigation and adaptation
  - win – wins
  - trade-offs

Current sources and sinks of CO_2



IPCC (2007)

Land ecosystems and oceans are buffering us from the full effects of our CO_2 emissions

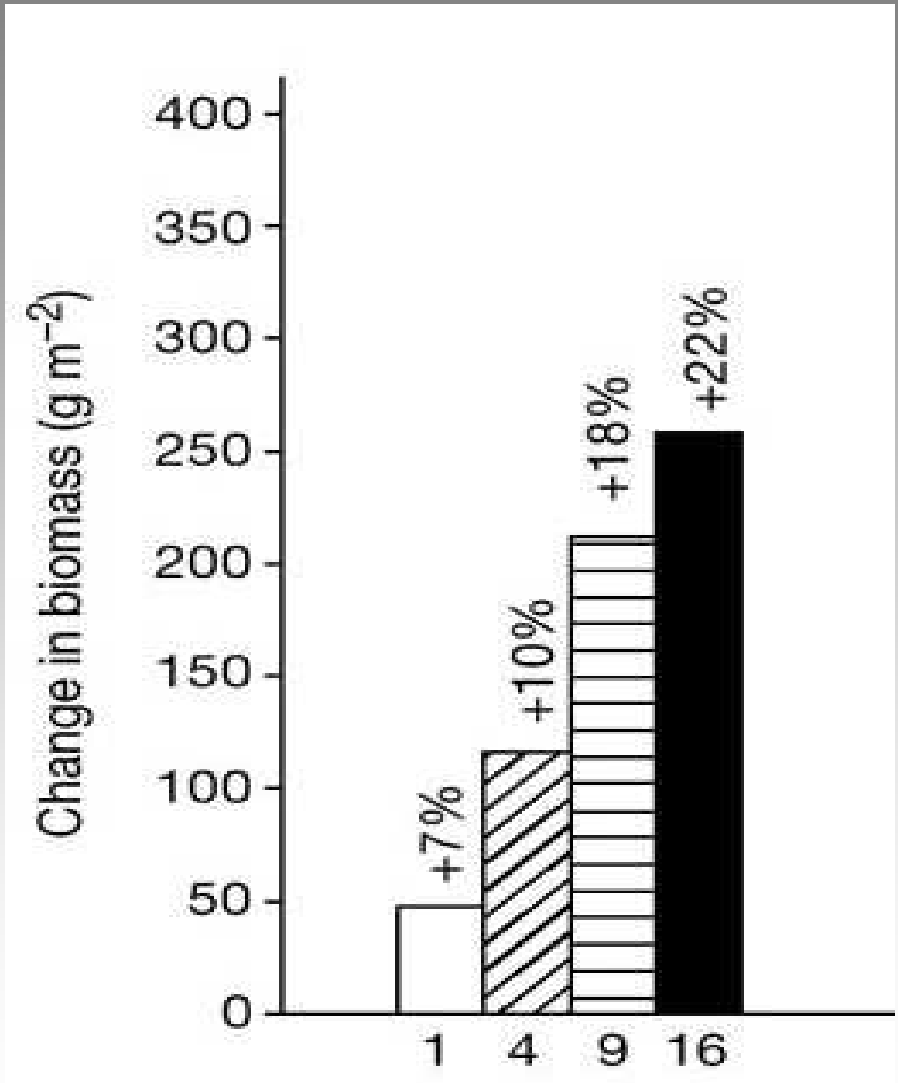


Annual rise in atmospheric CO_2 that would occur if all fossil fuel emissions remained in atmosphere

Actual observed annual rise in CO_2 (about 60% of emissions)

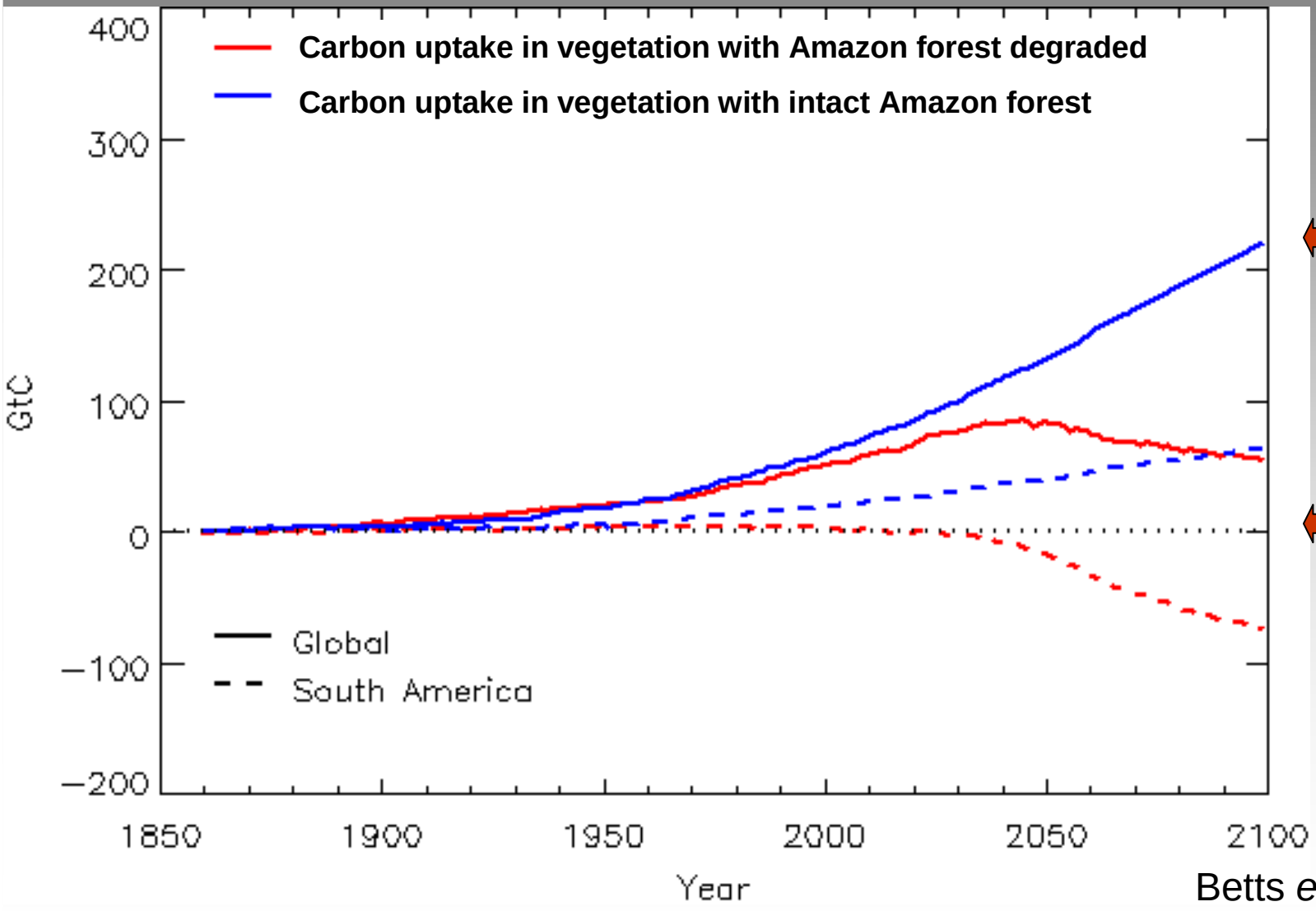
IPCC (2007)

Plant diversity enhances ecosystem carbon uptake under elevated CO_2



Reich et al., (2001)

Case study: damage to terrestrial carbon uptake service by loss of Amazon forest



Uptake of 220 billion tonnes of carbon in global vegetation

Betts *et al* (2004)

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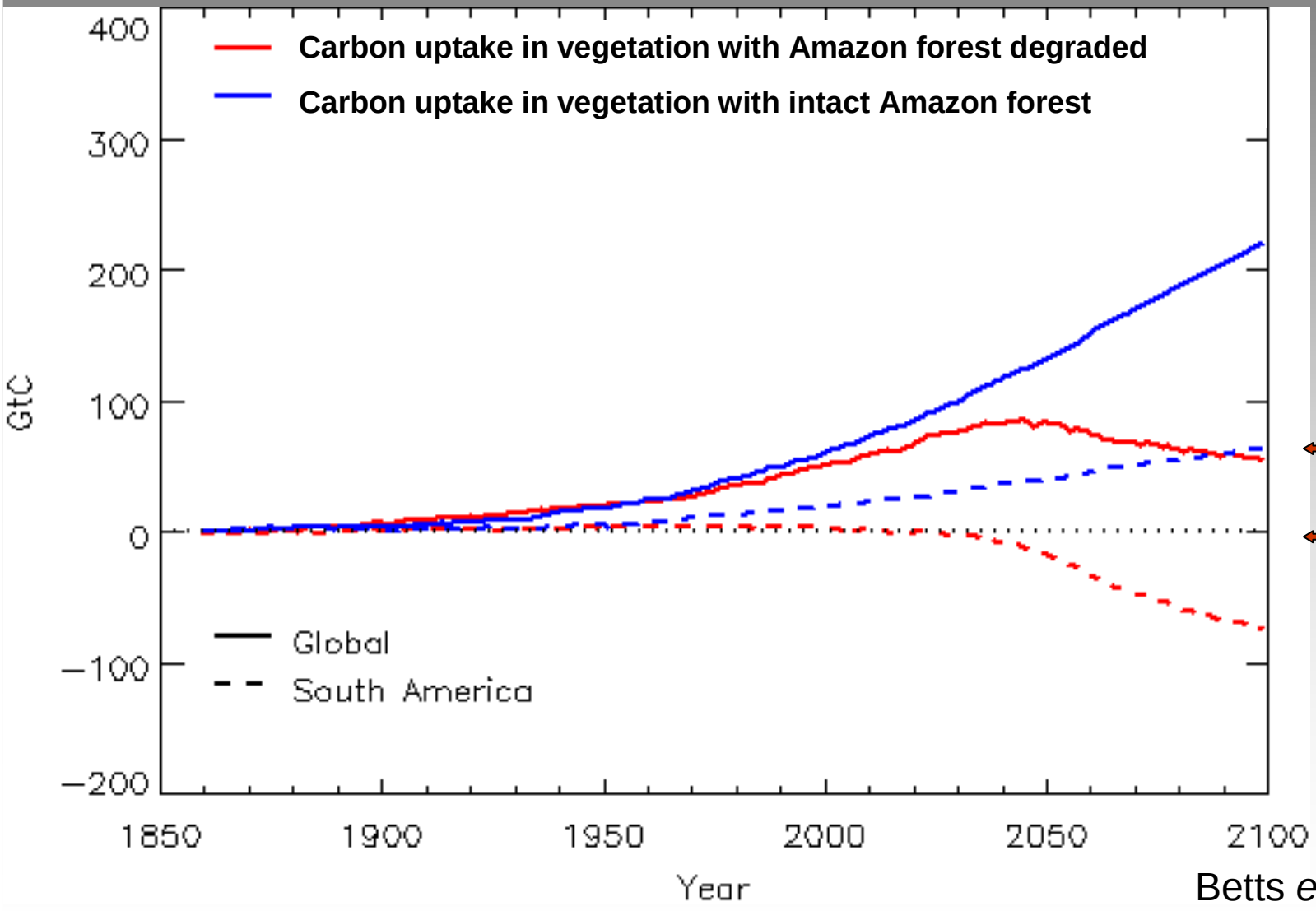
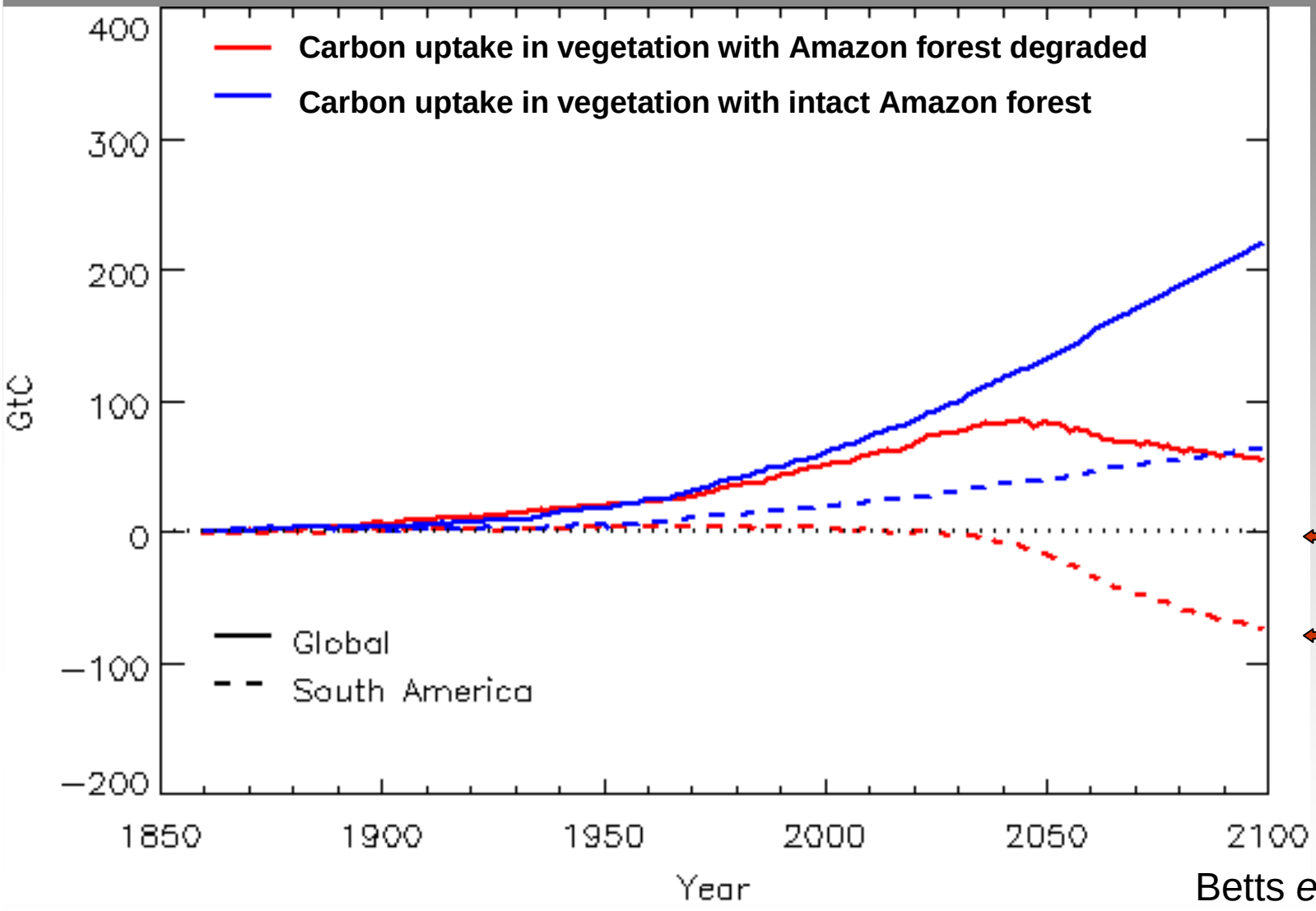


Uptake of 60 billion tonnes of carbon in South America (mostly in Amazon)

Betts *et al* (2004)

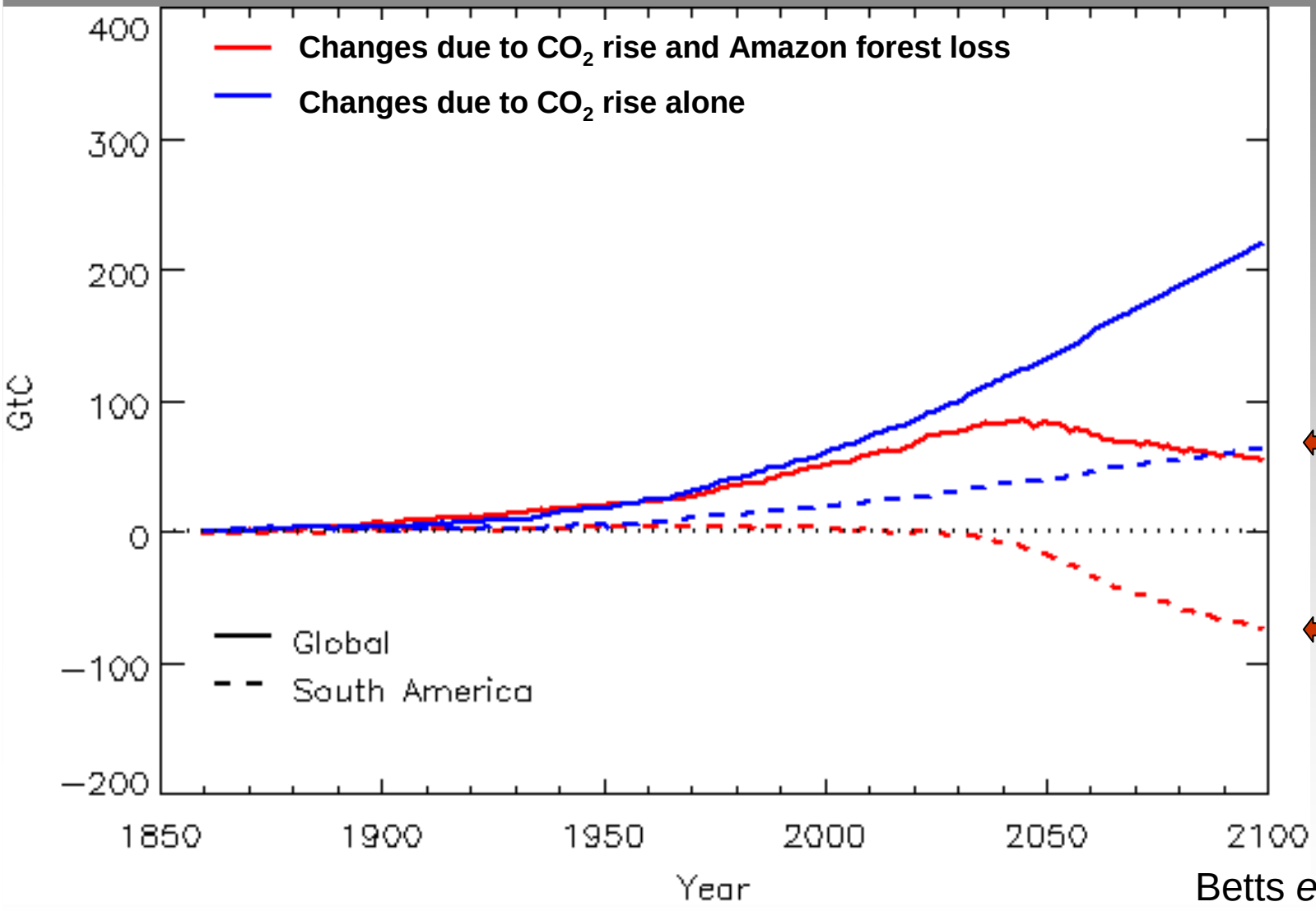
Case study: damage to terrestrial carbon uptake service by loss of Amazon forest



Loss of 70 billion tonnes of carbon due to loss of Amazon forest

Betts *et al* (2004)

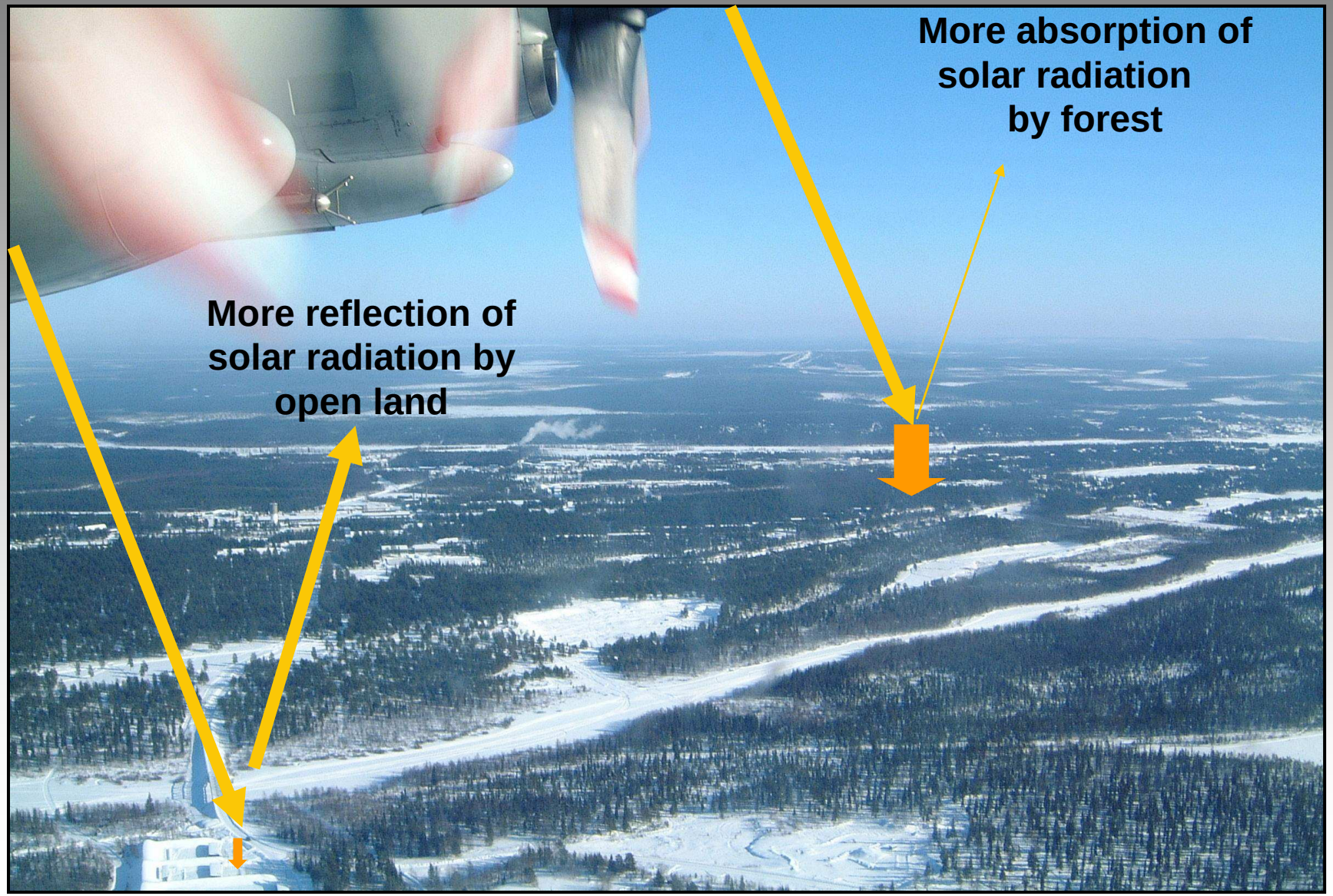
Case study: damage to terrestrial carbon uptake service by loss of Amazon forest



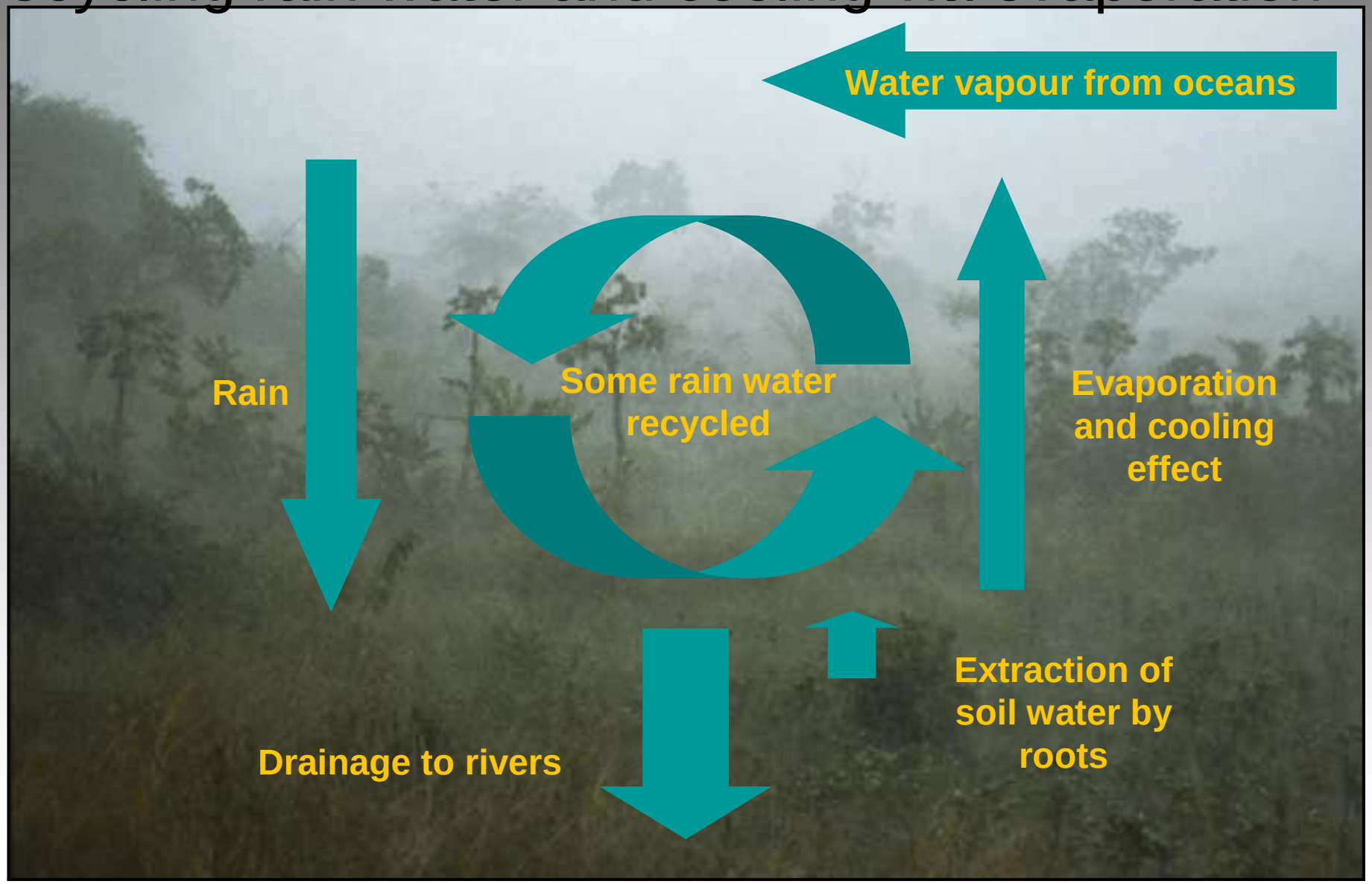
Total carbon deficit: 130 billion tonnes of carbon (amount released due to forest loss, plus lost opportunity for uptake)

Betts *et al* (2004)

Beyond carbon: effects of ecosystems on climate via surface albedo (reflectivity)

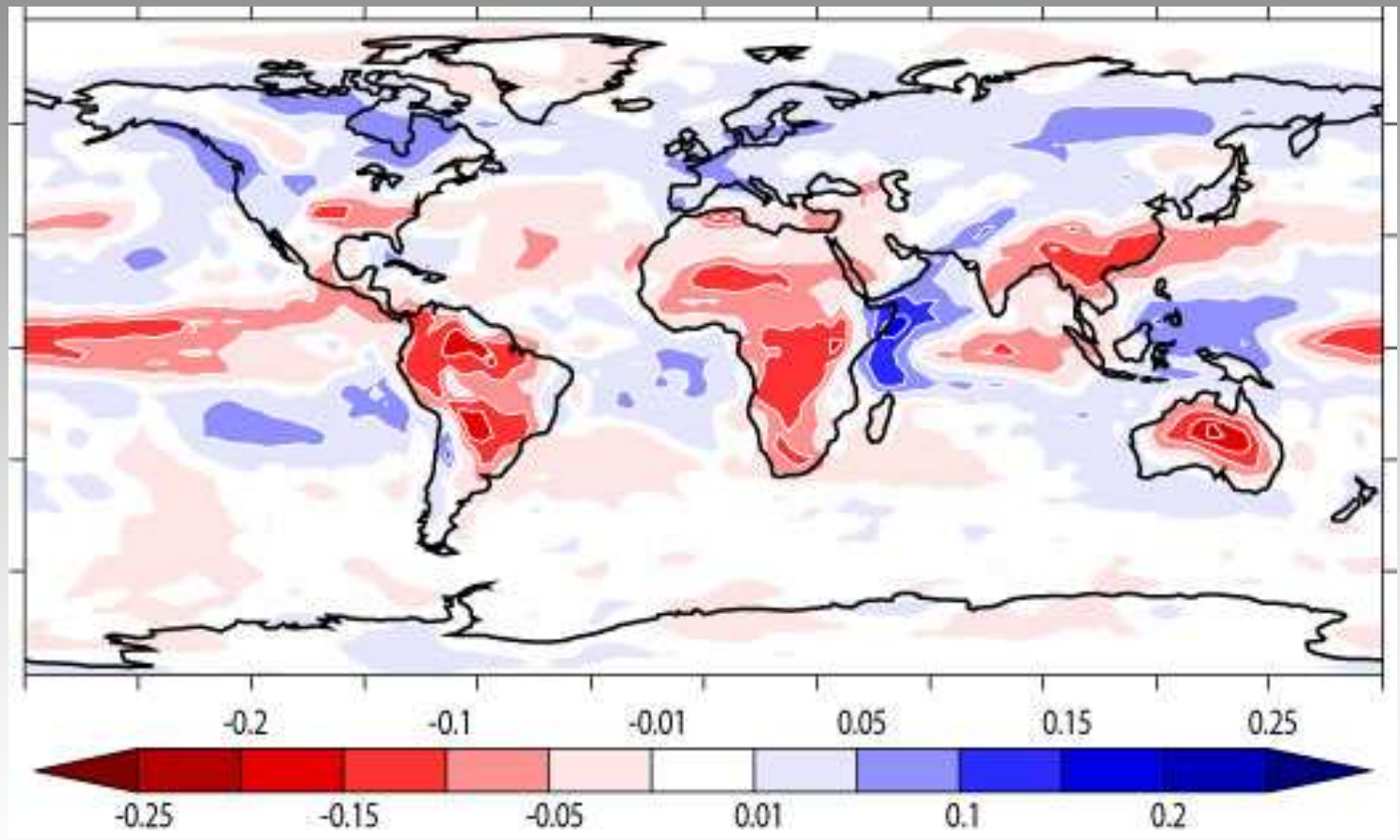


Beyond carbon: ecosystem effects on climate by recycling rain water and cooling via evaporation



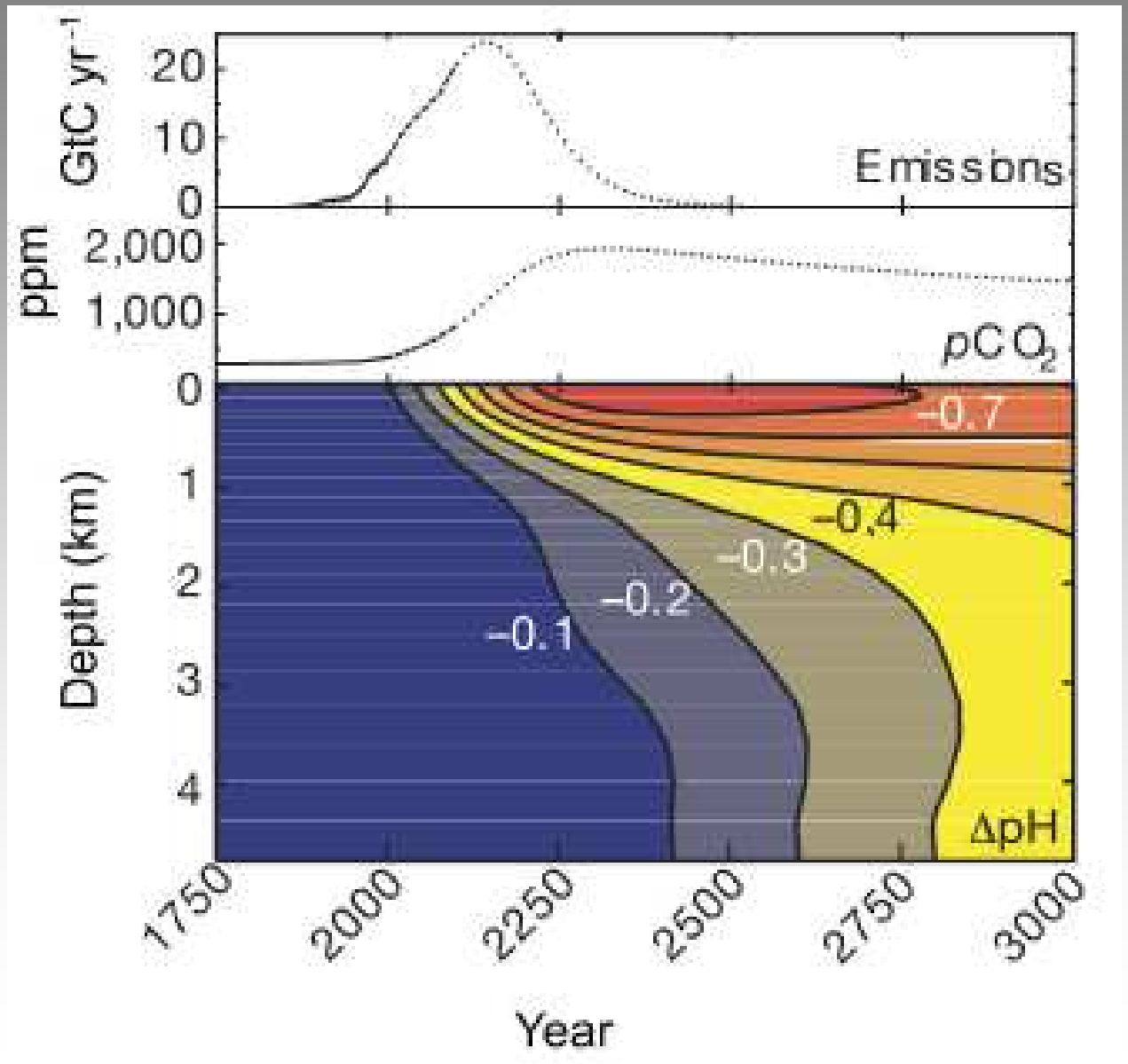
Beyond carbon: a world without forests, up to 25% loss of cloud cover

- Evaporative loss => decrease of clouds in the tropics



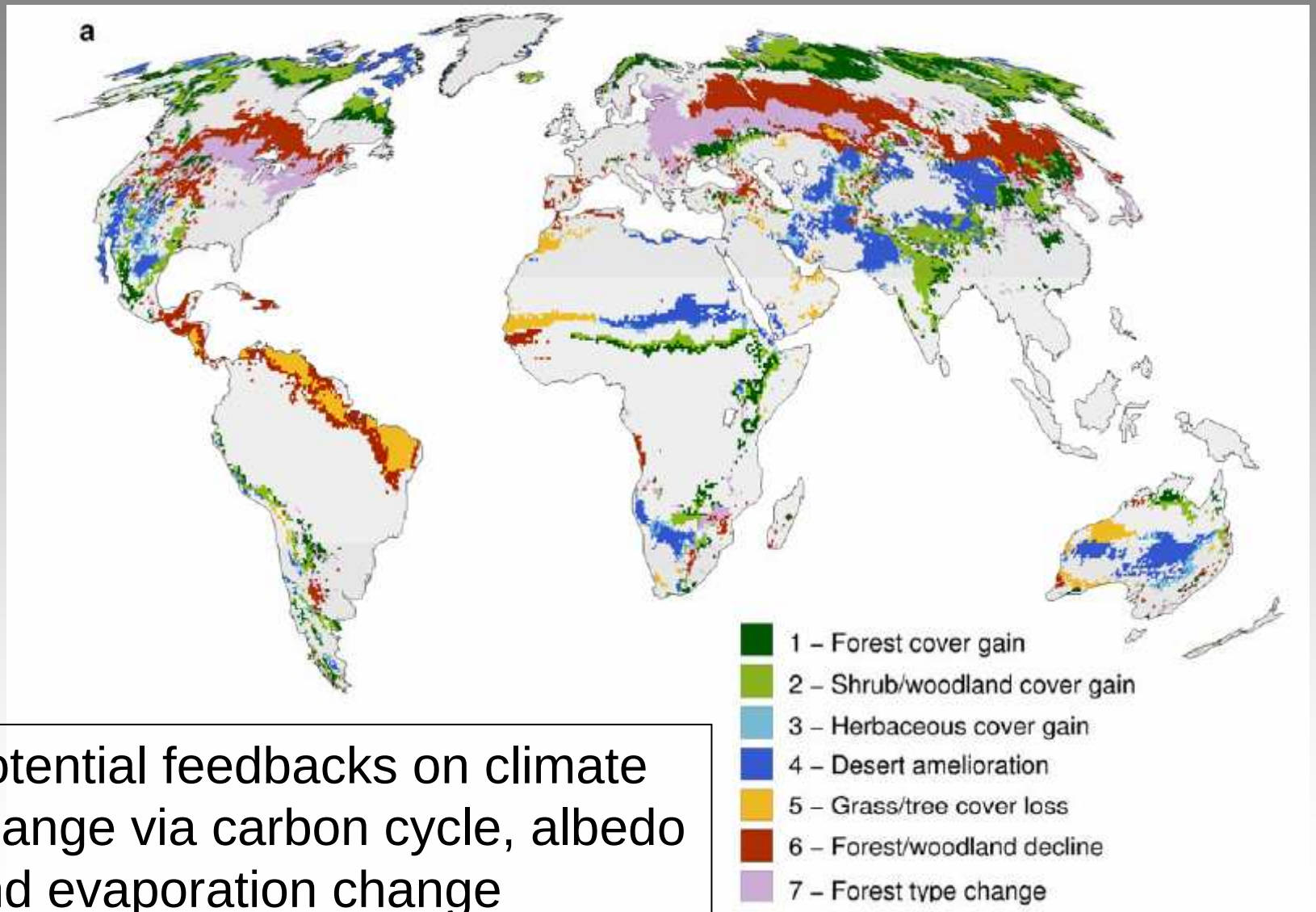
Bala et al (2007)

Beyond the greenhouse effect: effects of rising CO_2 on ocean acidification



IPCC (2007)

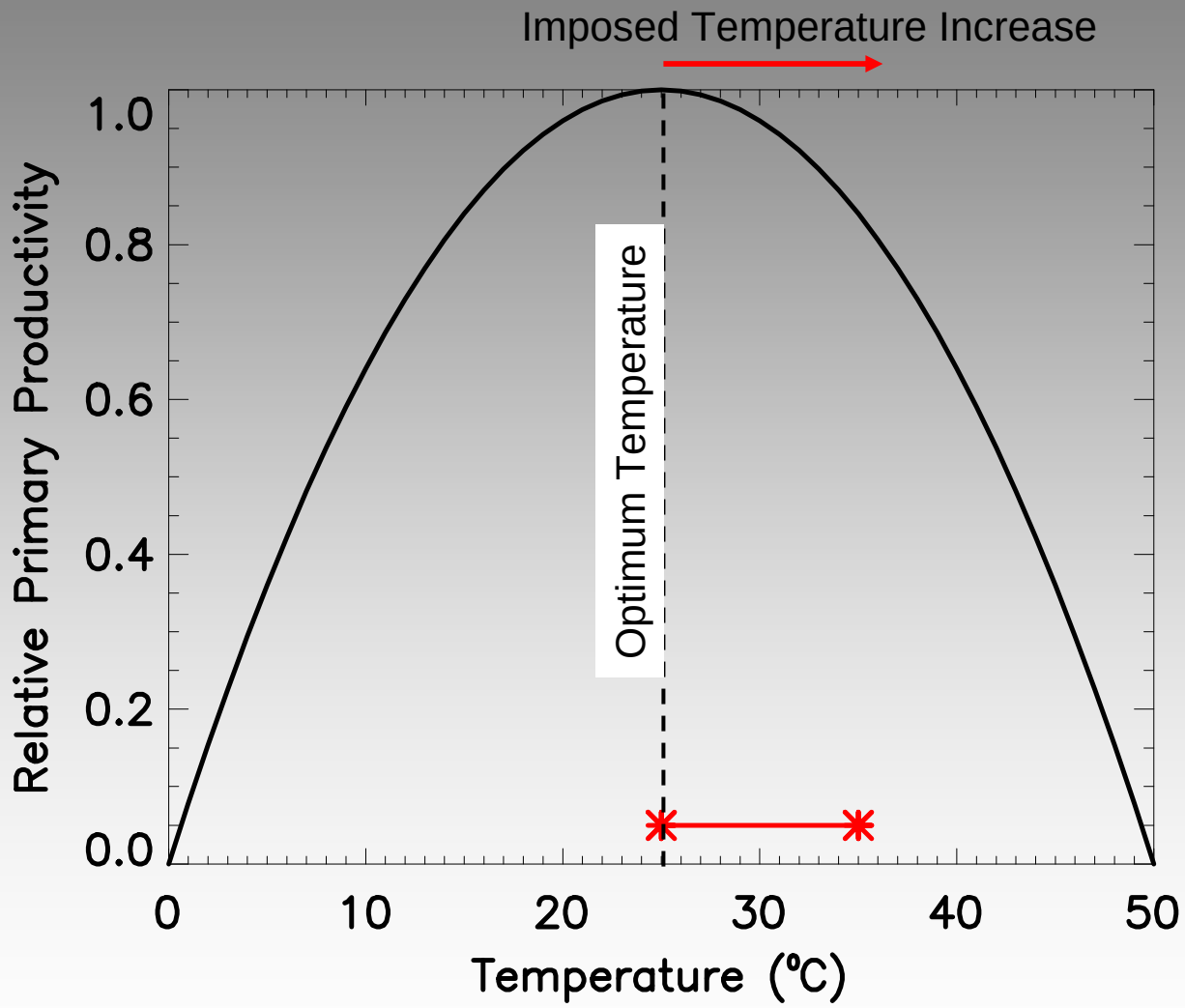
Potential impacts of climate change on major land ecosystems (1 climate model, 1 ecosystem model)



Potential feedbacks on climate change via carbon cycle, albedo and evaporation change

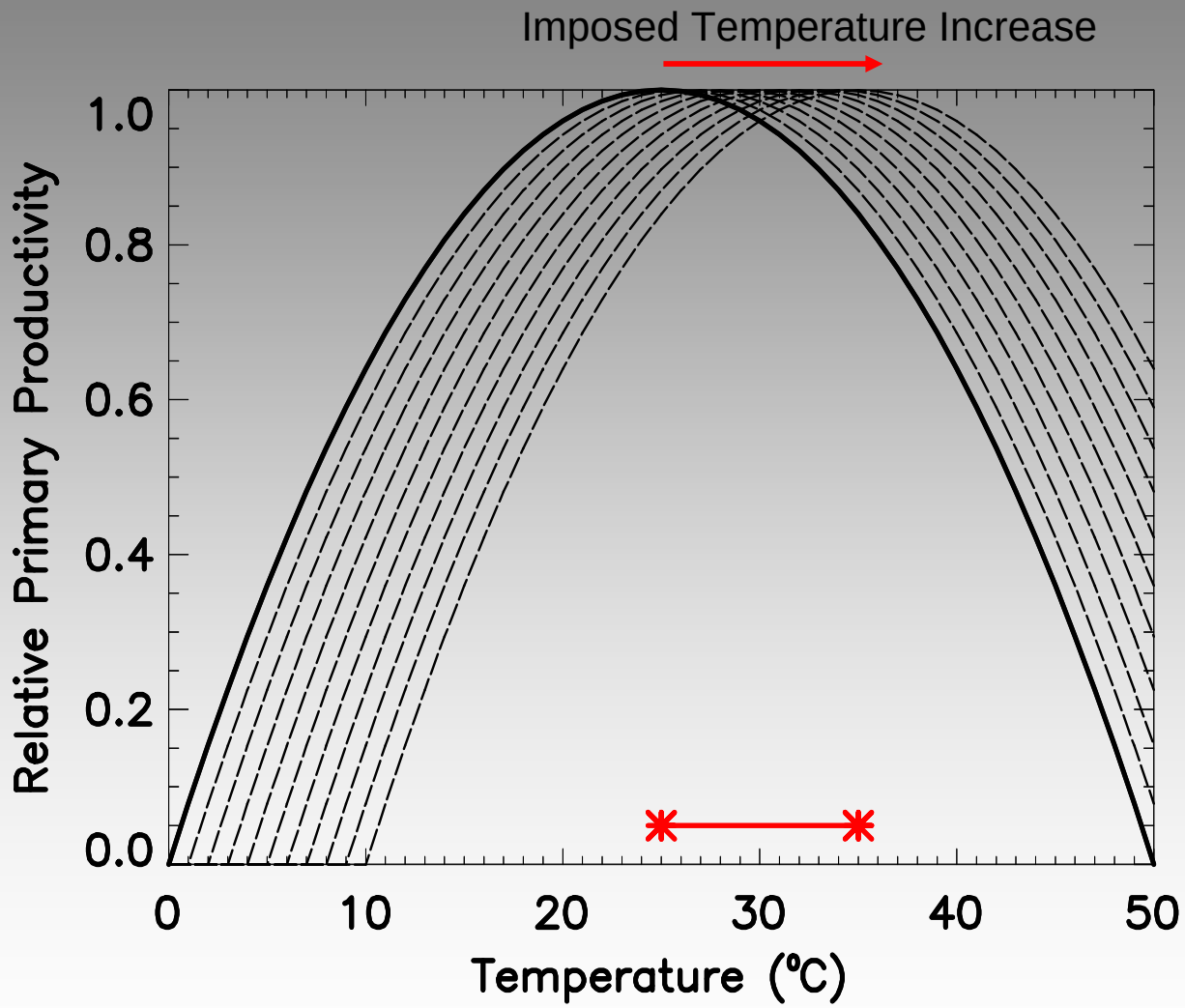
IPCC (2007)

Biodiversity and ecosystem resilience: single species response to climate change



P.M.Cox

Biodiversity and ecosystem resilience: diverse ecosystem response to climate change



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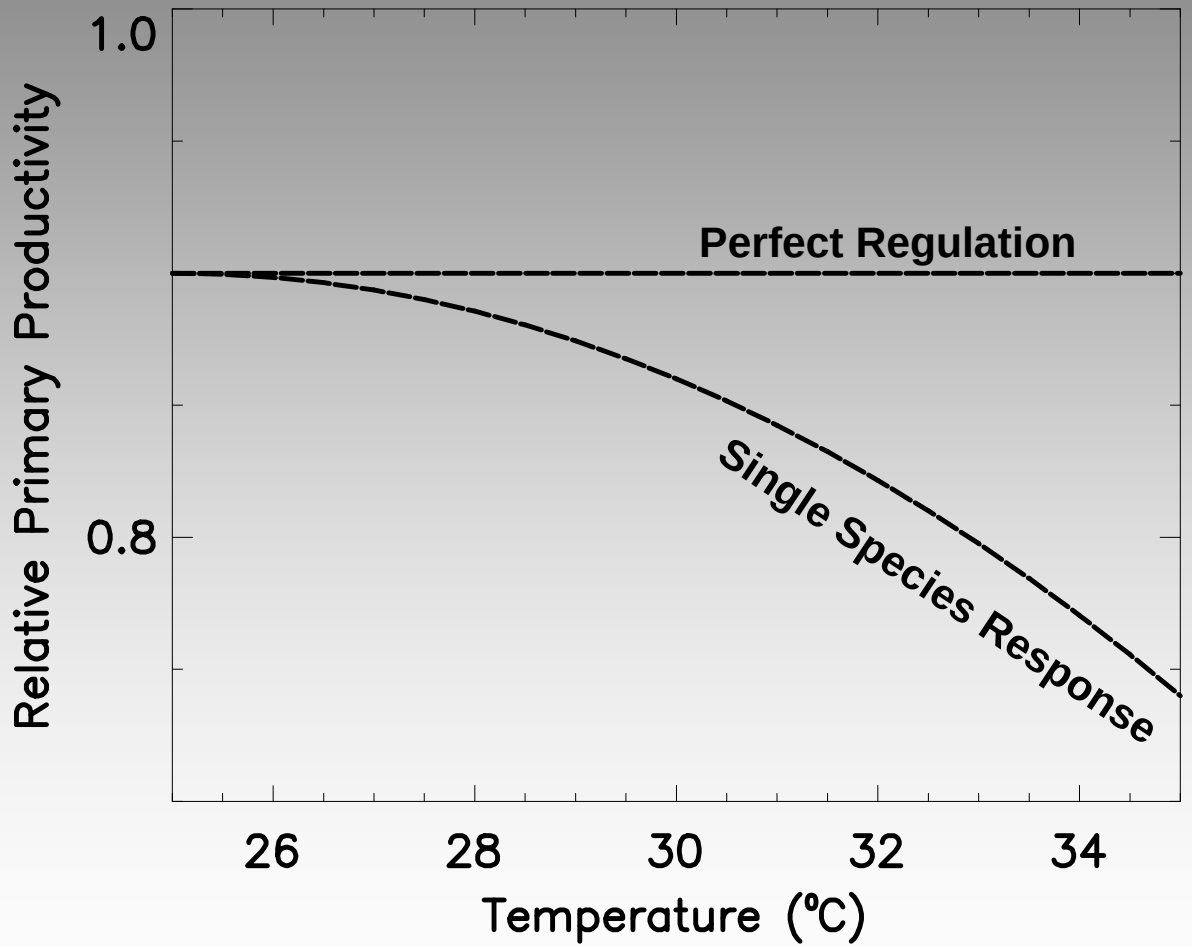
Biodiversity and ecosystem resilience: reduction in plant productivity



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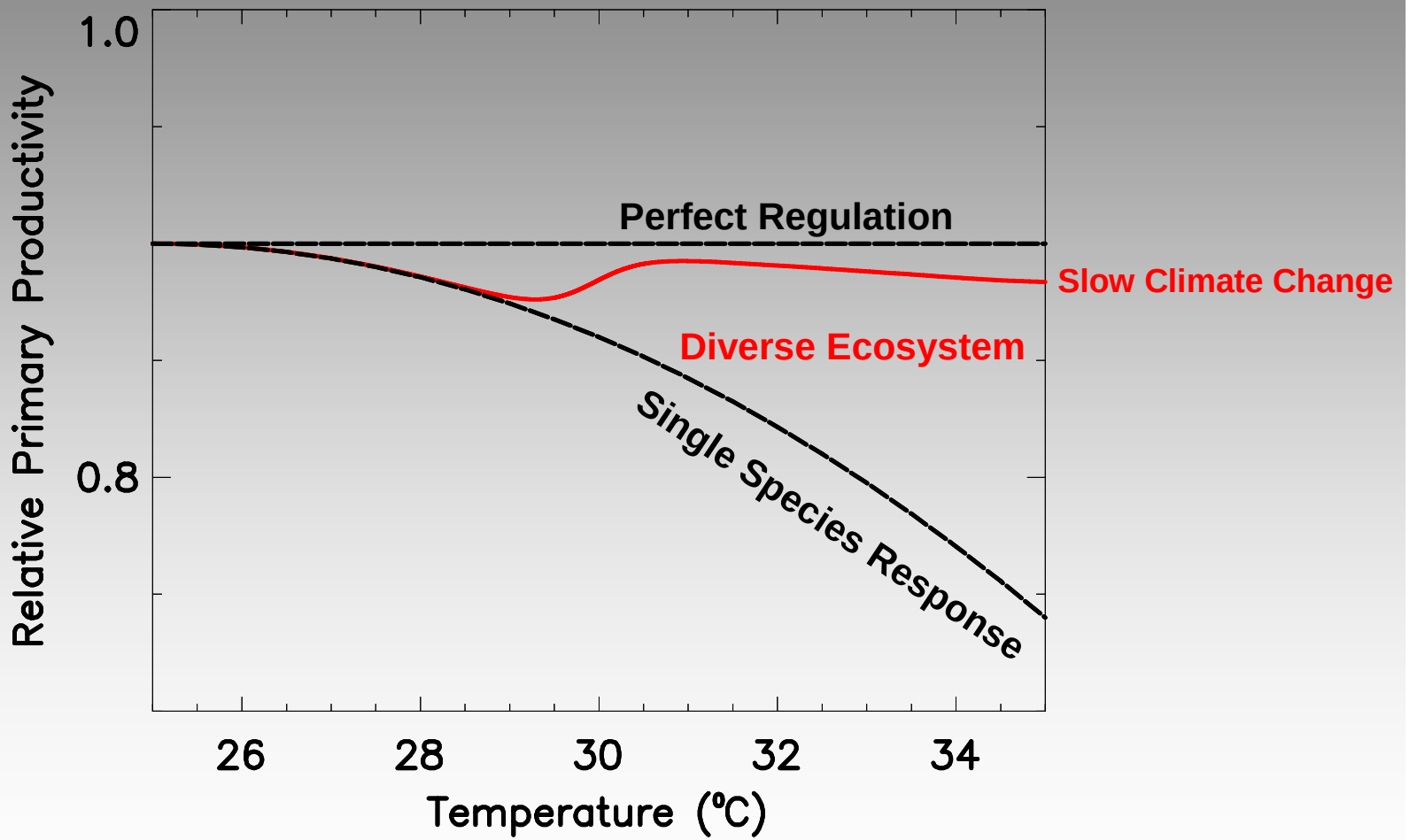

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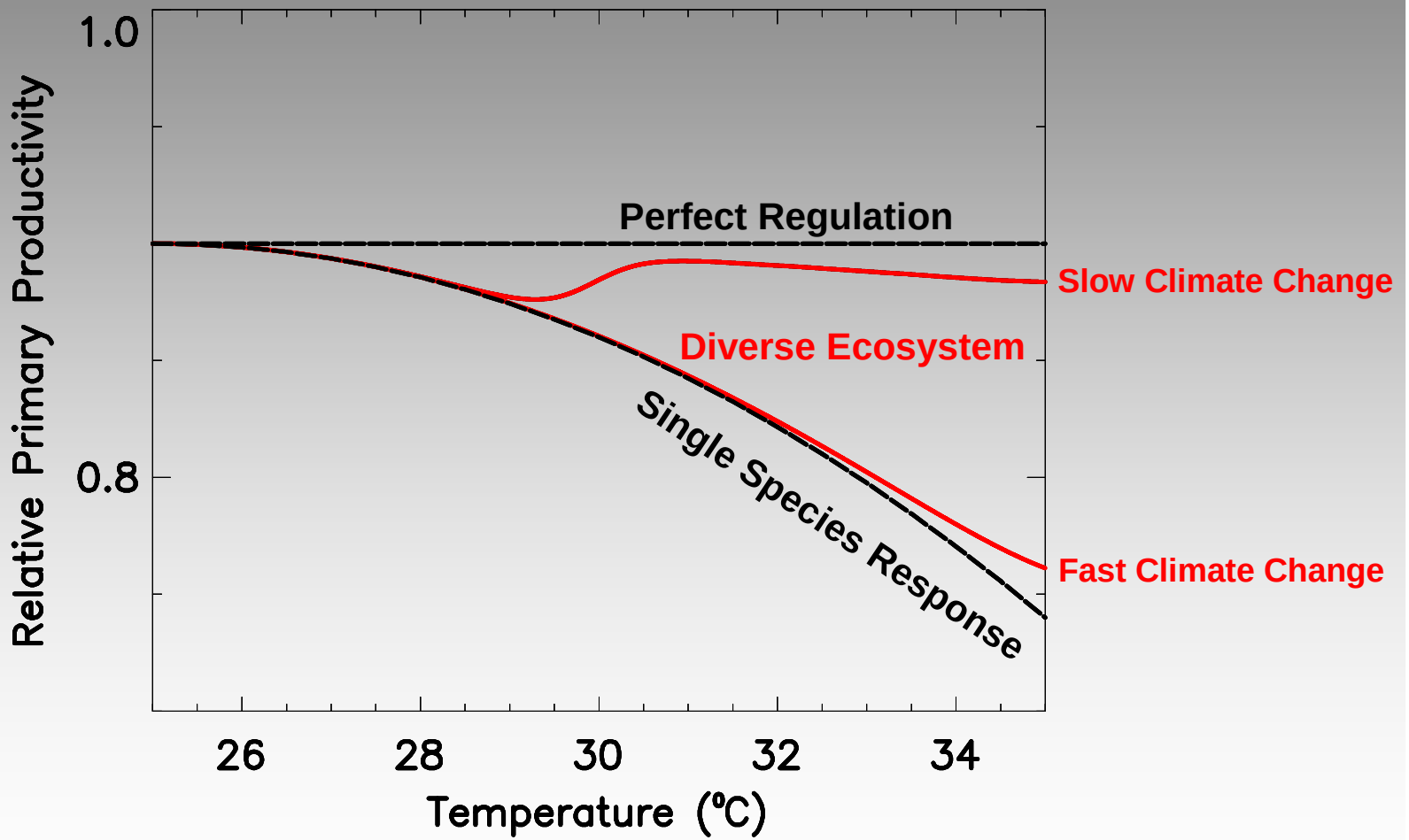

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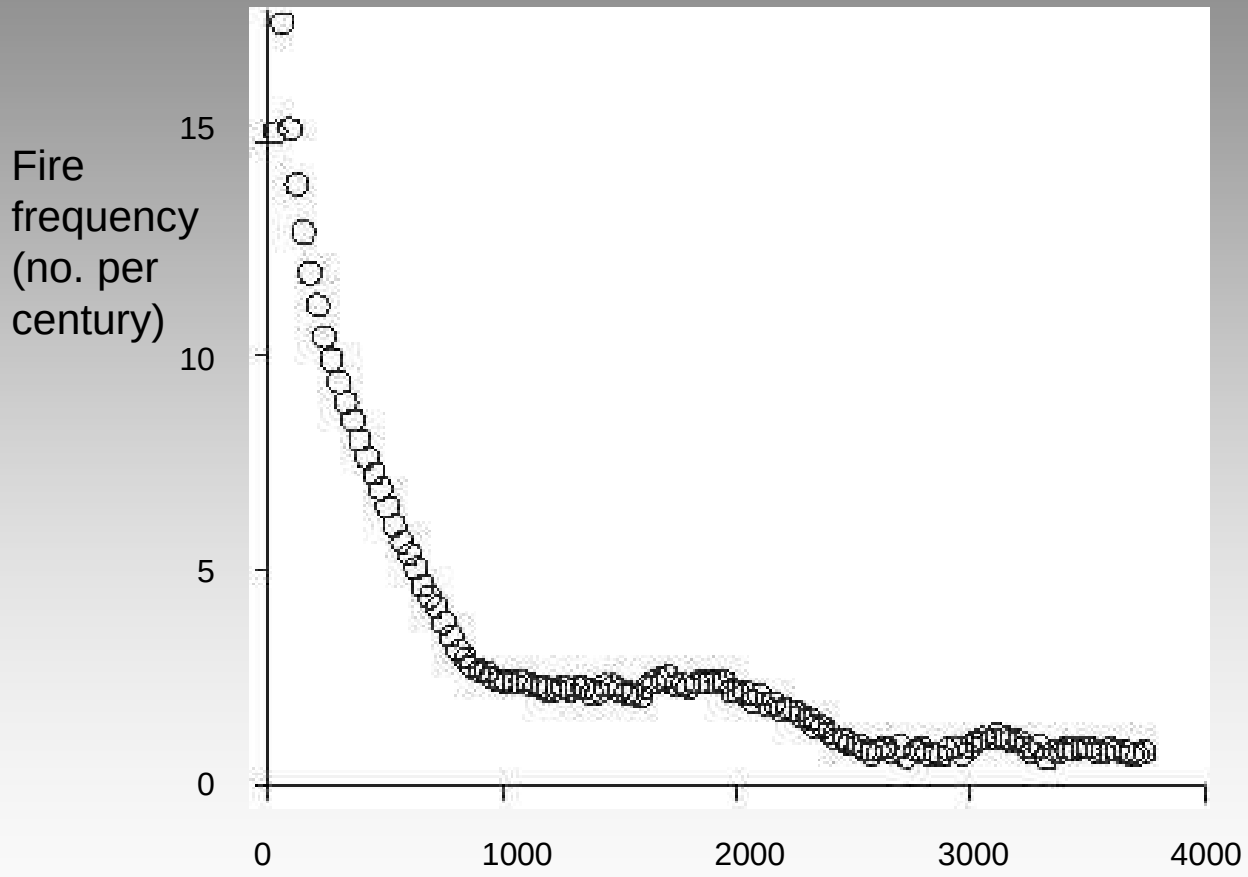
Indirect effects of ecosystem degradation: reduced resilience to climate change

Forest Fragmentation (satellite image)



Laurence (2004)

Trade-offs between climate change mitigation and biodiversity

- Afforestation and biofuels are two proposed options for reducing net emissions
- But monoculture plantations reduce biodiversity
- May therefore be more vulnerable to climate change
- Preservation of existing forests maintains biodiversity and resilience against climate change

Key messages

- Ecosystems and biodiversity play key roles in climate
- Ecosystem degradation directly contributes to climate change
- Degradation increases ecosystem vulnerability to climate change
- Reducing ecosystem degradation helps to limit climate change damages in a number of ways
- - reduces carbon emissions
- - *and* maintains carbon sink
- - *and* maintains other ecosystem services
- Protecting biodiversity helps tackle climate change
- Some climate change mitigation options may damage biodiversity and may themselves be vulnerable to climate change