

THE ImpEE
PROJECT

IMPROVING
ENGINEERING
EDUCATION

Climate Change and Sustainability

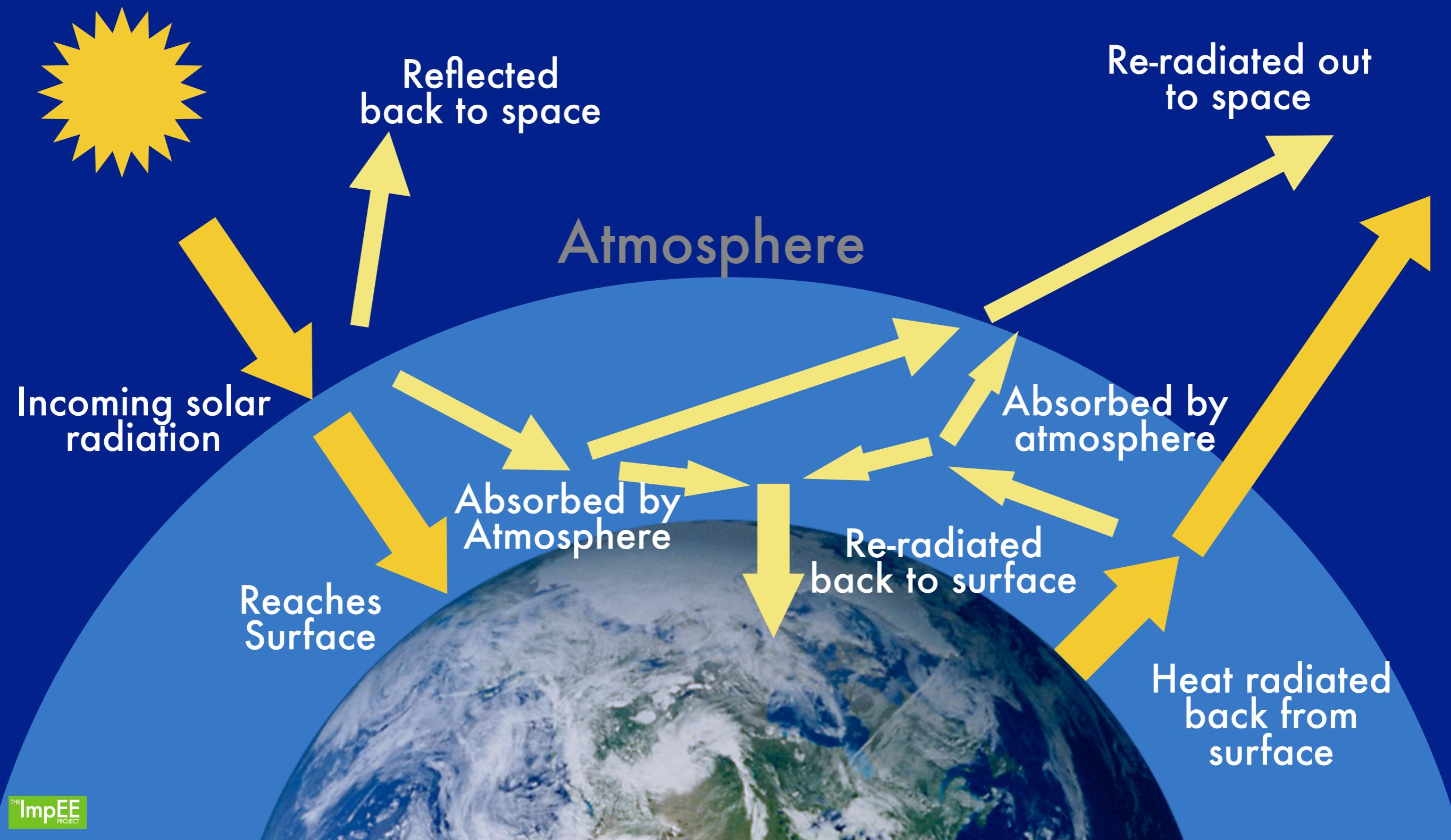


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The Greenhouse Effect



Greenhouse Gases

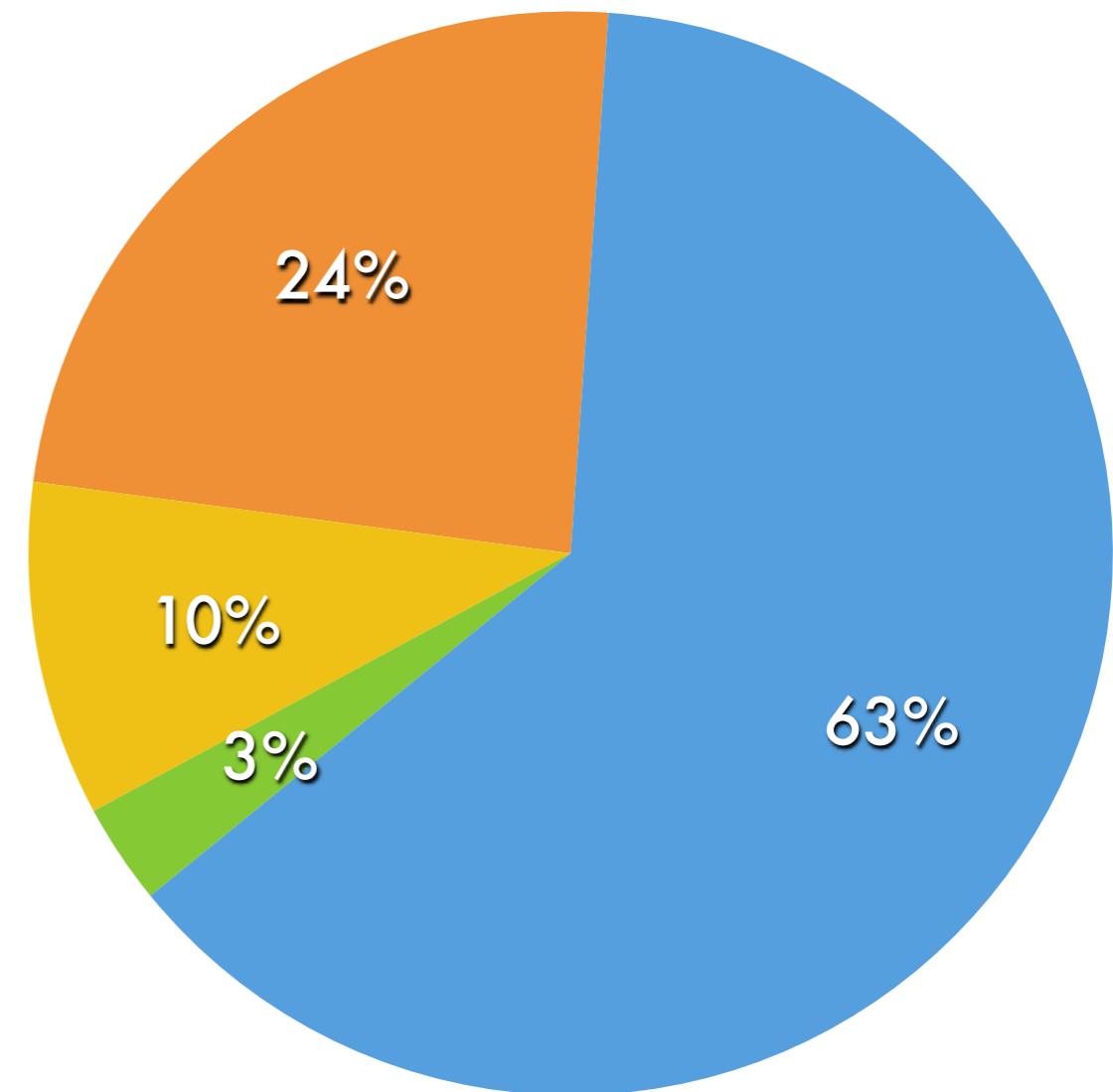
The most talked about factors contributing to Global warming are Greenhouse Gases (GHG)

Gas	CO ₂ Equivalent	Amount	Residence Time
H ₂ O	N/A	~1%	Days
CO ₂	1	350 ppm	~50 years
CH ₄	21	1800 ppb	12 years
N ₂ O	310	320 ppb	114 years
CFCs	6,500	~1 ppb	100 years
SF ₆	23,900	5 ppt	3,200 years

CO₂ is not the only greenhouse gas

- Taking into account the affectivity, residence, and concentration of the different gases:

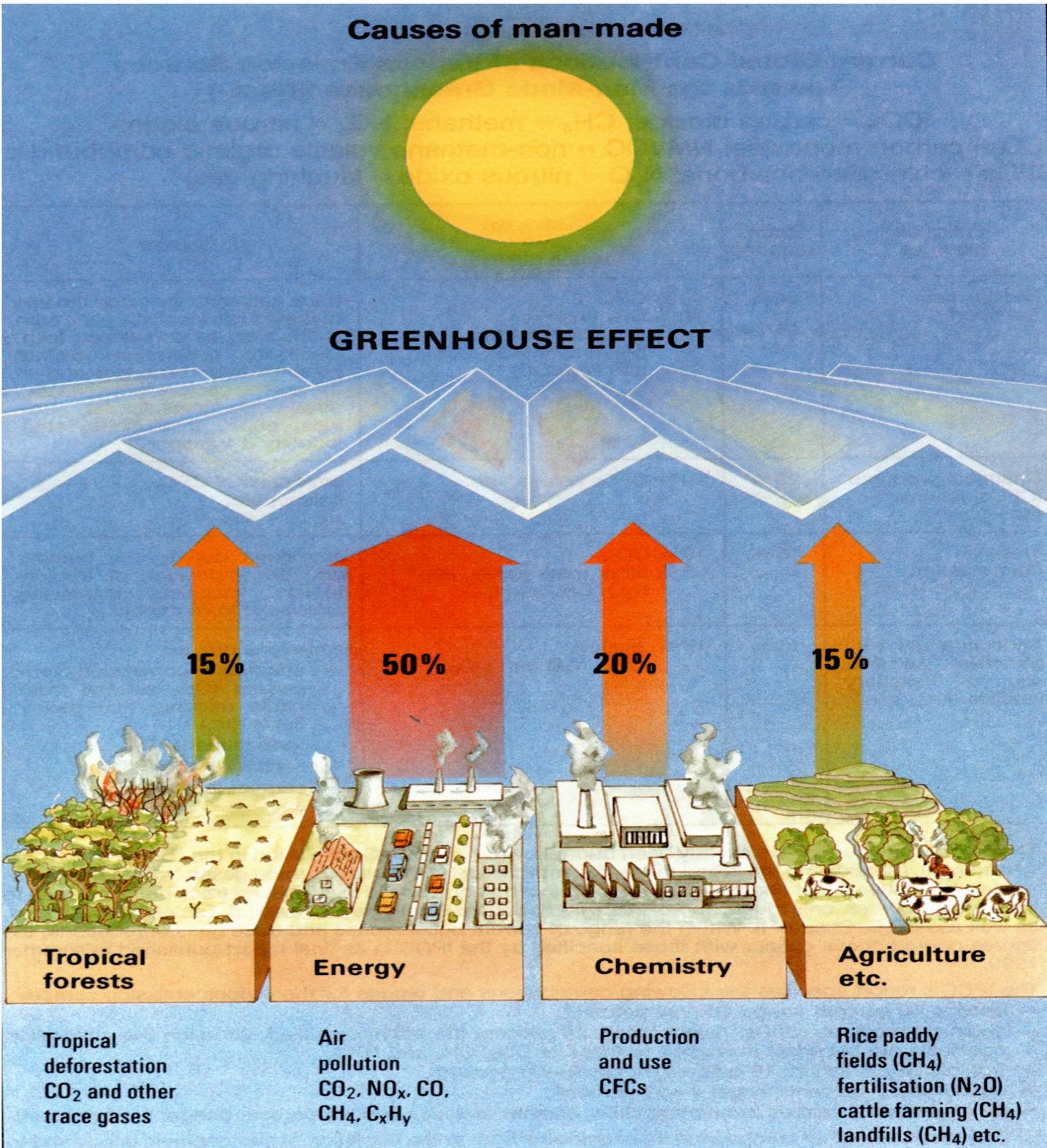
The relative warming of different greenhouse gases based on current emissions, effect quantified over the next 100 years



Sources and Lifetimes of Greenhouse Gases

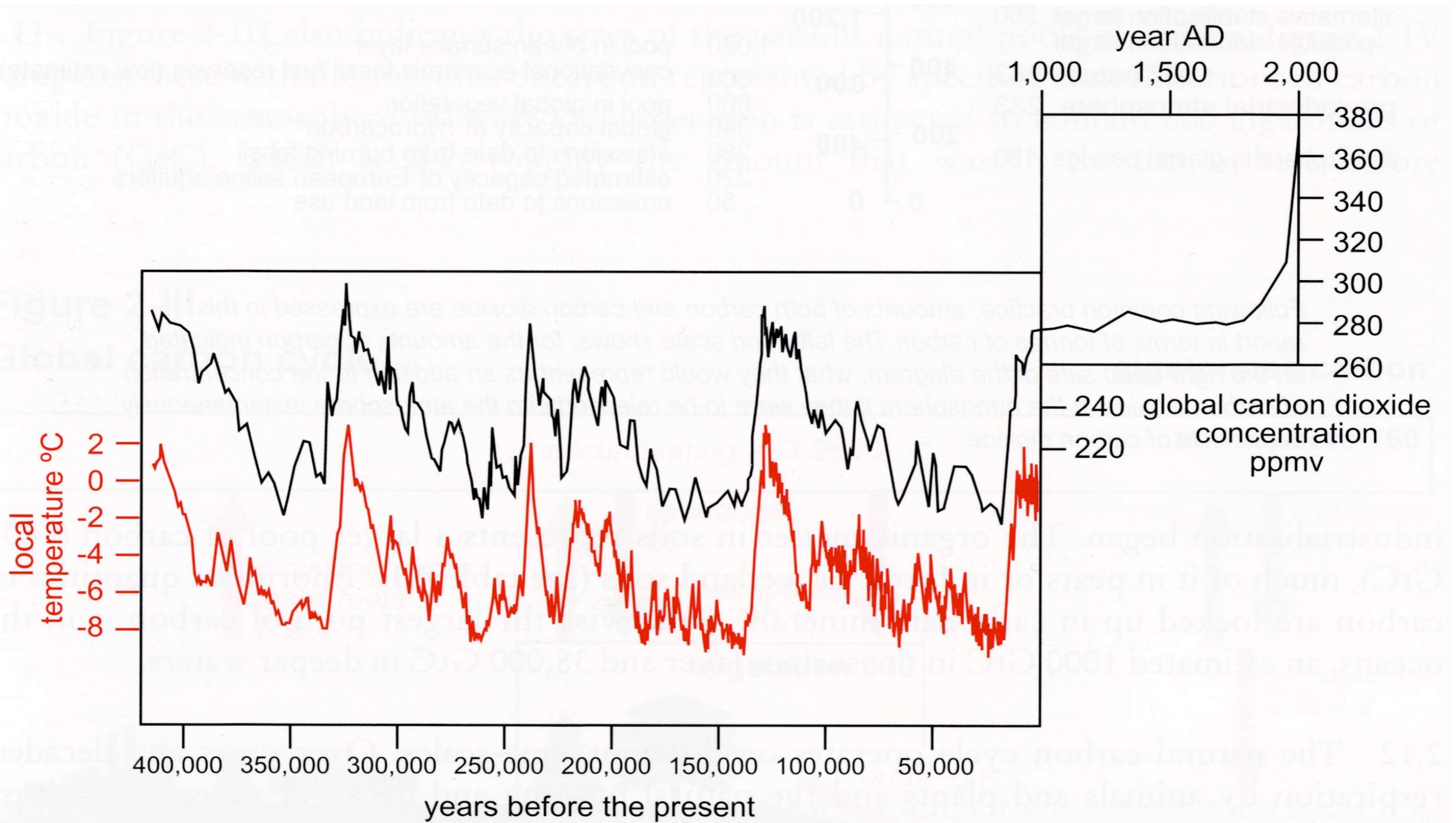
- Carbon Dioxide (CO₂):
100 years
- Methane: 10 years
- Nitrous Oxide: 150 years
- Chlorofluorocarbons: 100 years

(Source: Hadley Centre for Climate Prediction and Research)

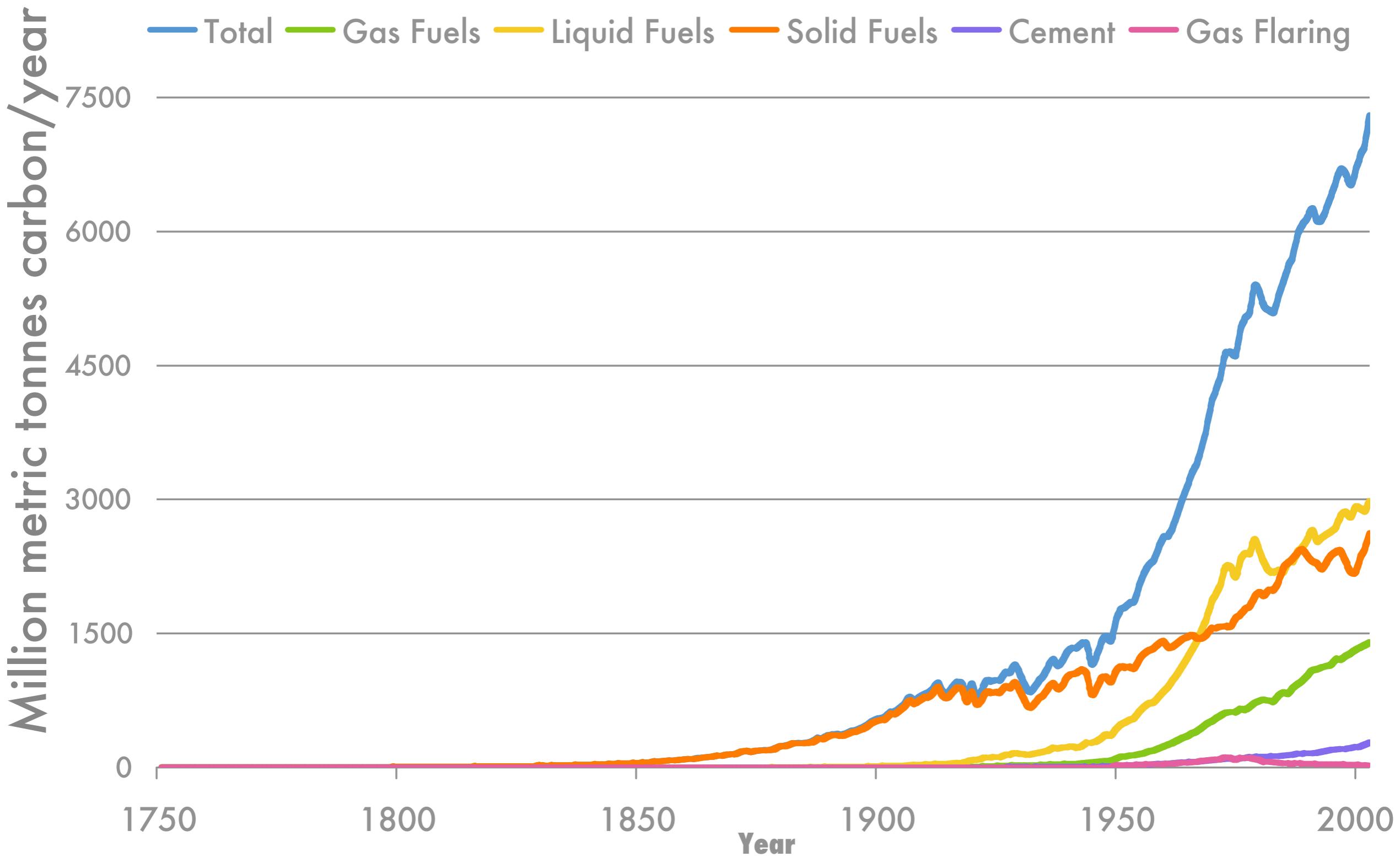


Evidence for the Impact of CO₂

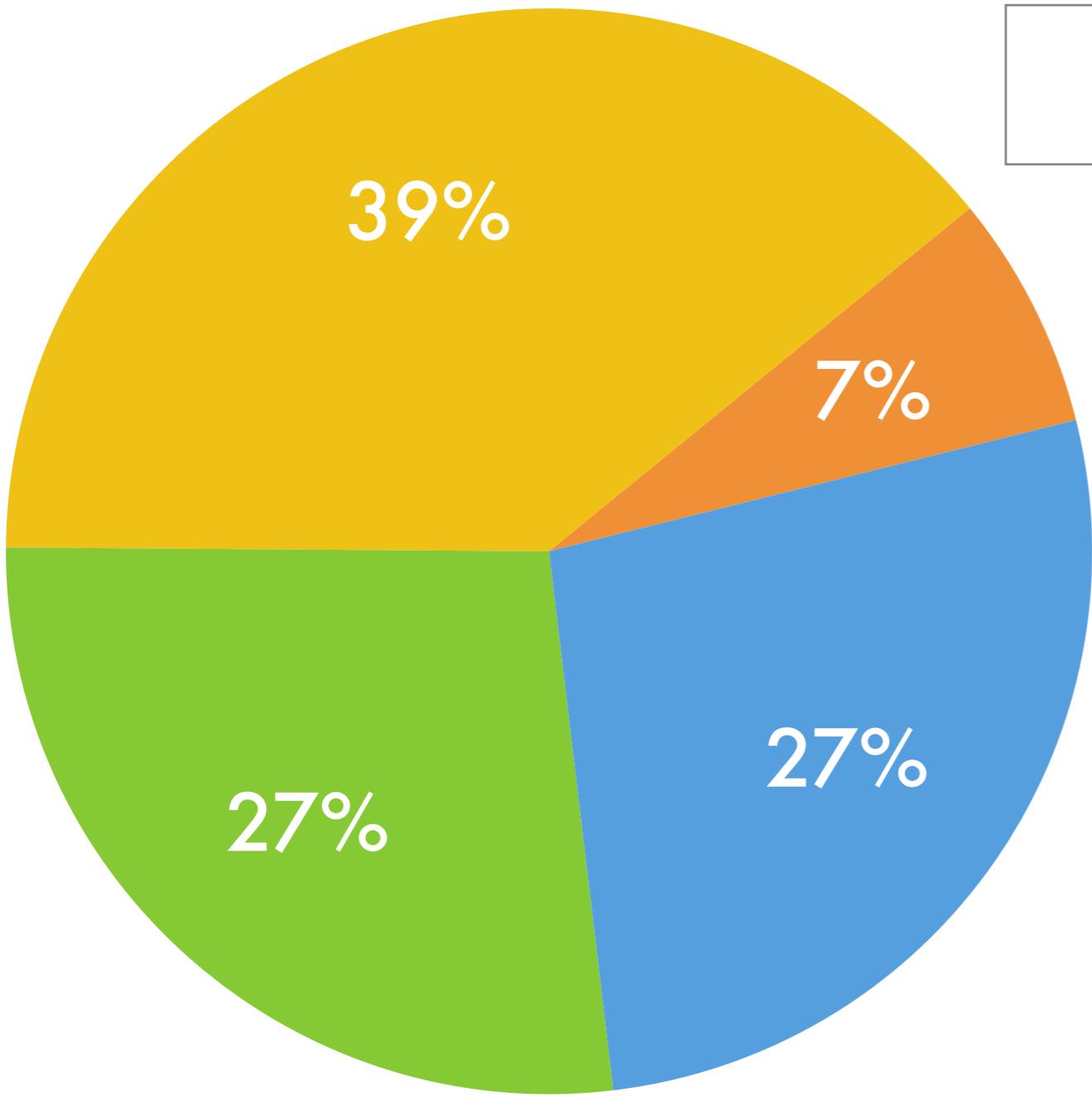
Vostok Ice-Core and Temperature graph



Anthropogenic CO₂ Forcings



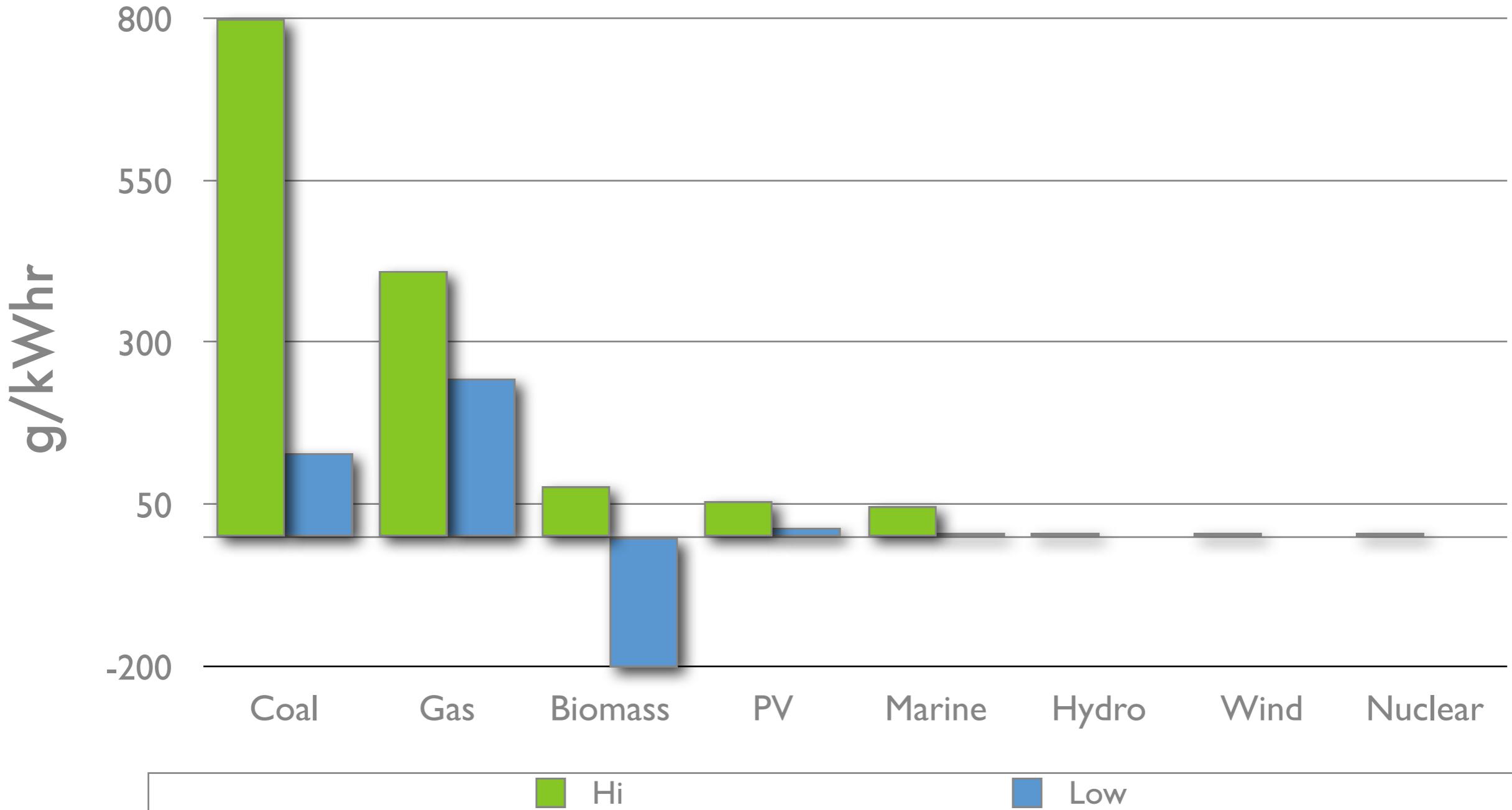
Carbon Dioxide Emissions



Carbon Dioxide
Emissions by End User

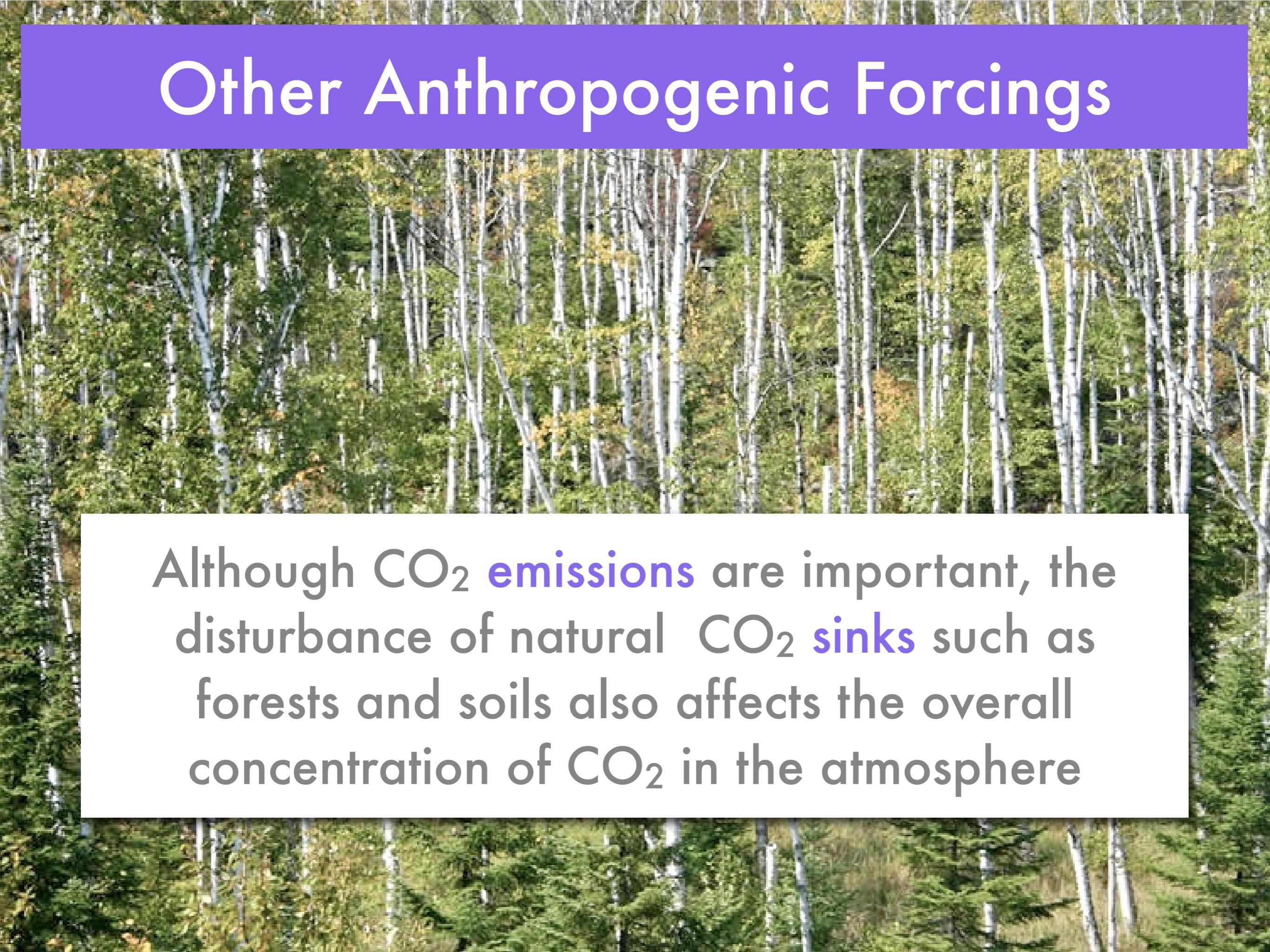


CO₂ Emissions from Fossil Fuels



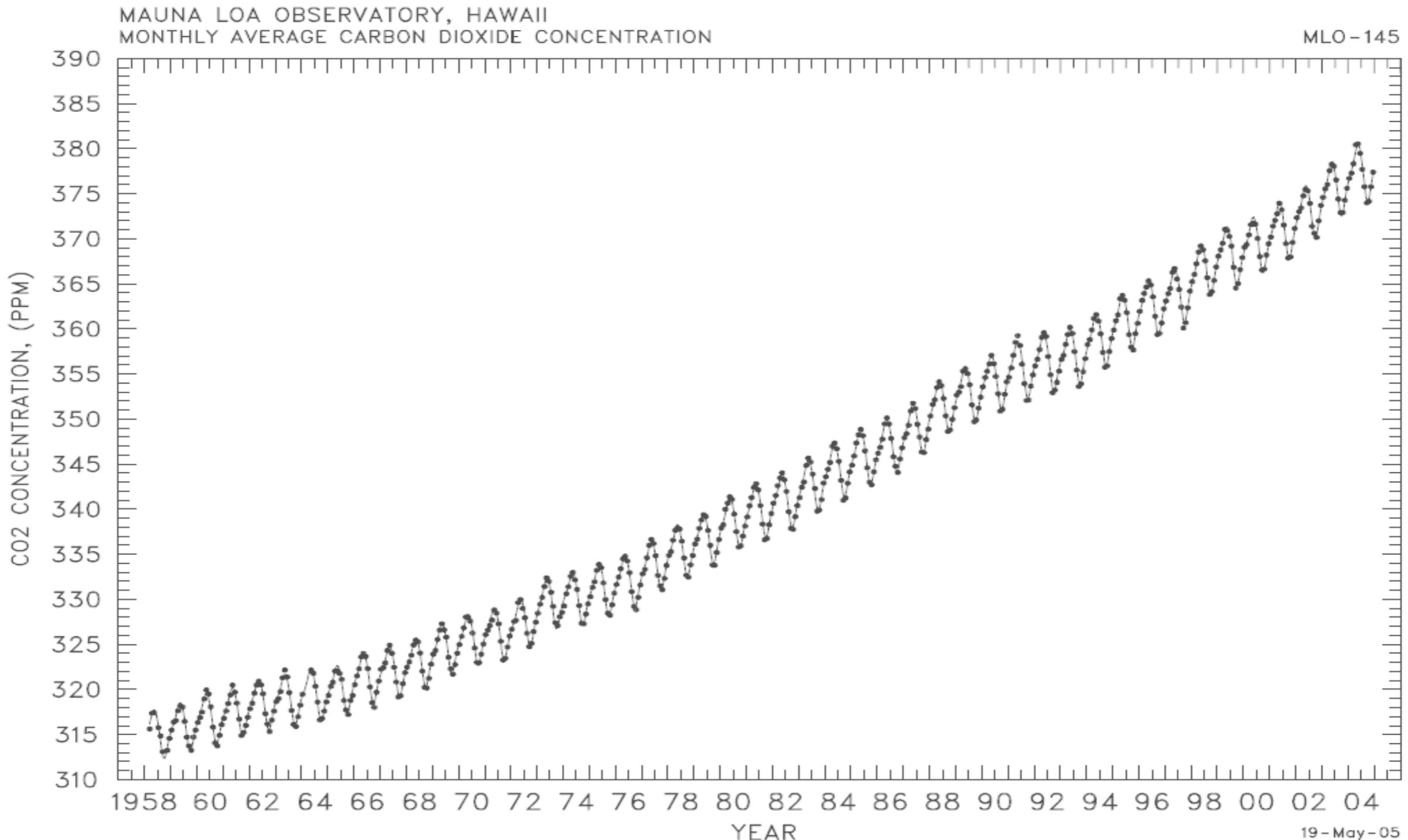
Comparison of high and low lifetime carbon emissions for all technologies
(grams of carbon dioxide per kilowatt hour)

Other Anthropogenic Forcings



Although CO₂ **emissions** are important, the disturbance of natural CO₂ **sinks** such as forests and soils also affects the overall concentration of CO₂ in the atmosphere

CO₂ Concentrations in the Atmosphere (measured at Mauna Loa, Hawaii)



Impacts of Climate Change

- Health risks
- Decreased agricultural productivity
- Increased storminess



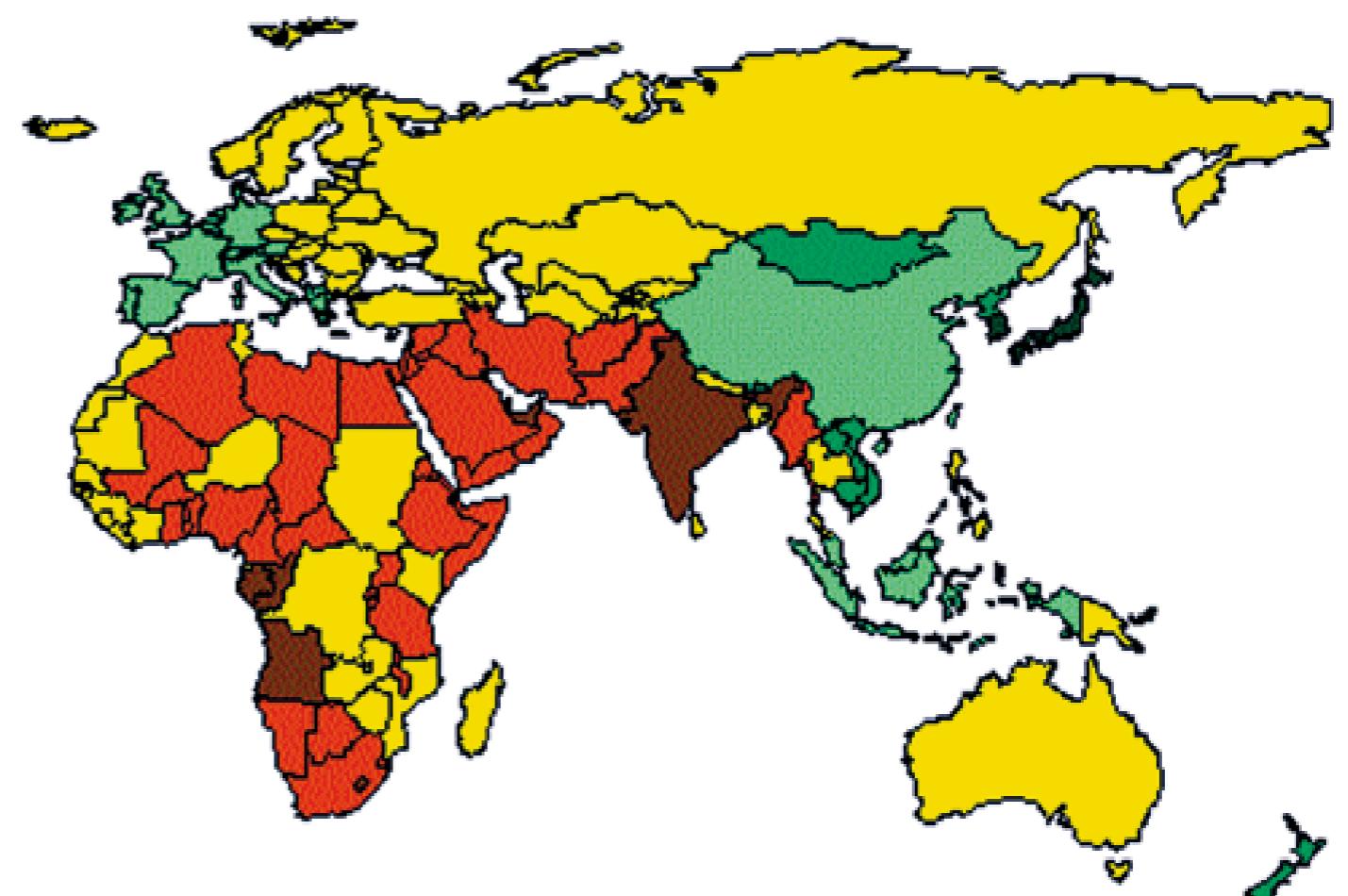
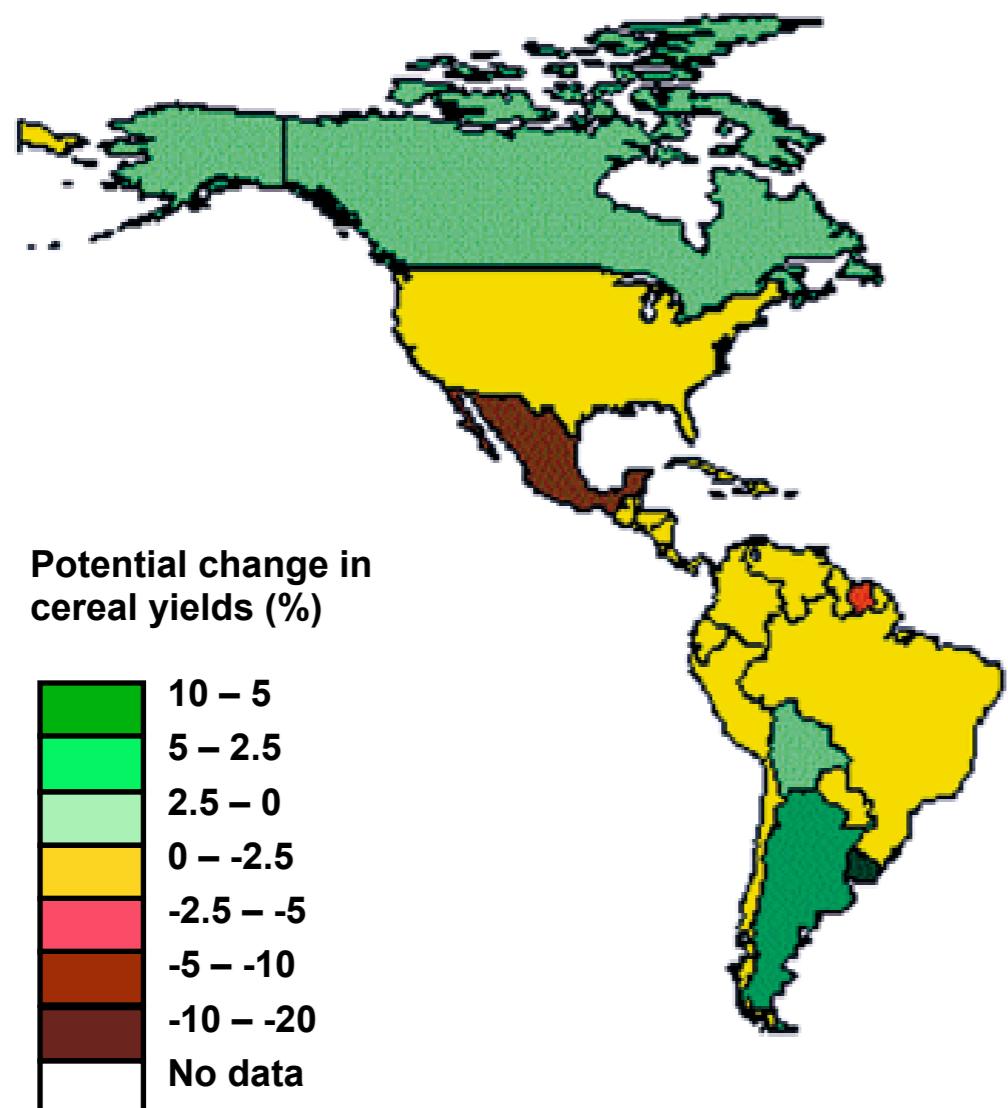
Impacts of Climate Change

- Coastal flooding from rising sea levels
- River flooding from more heavy rainfall events
- Water supply problems from droughts



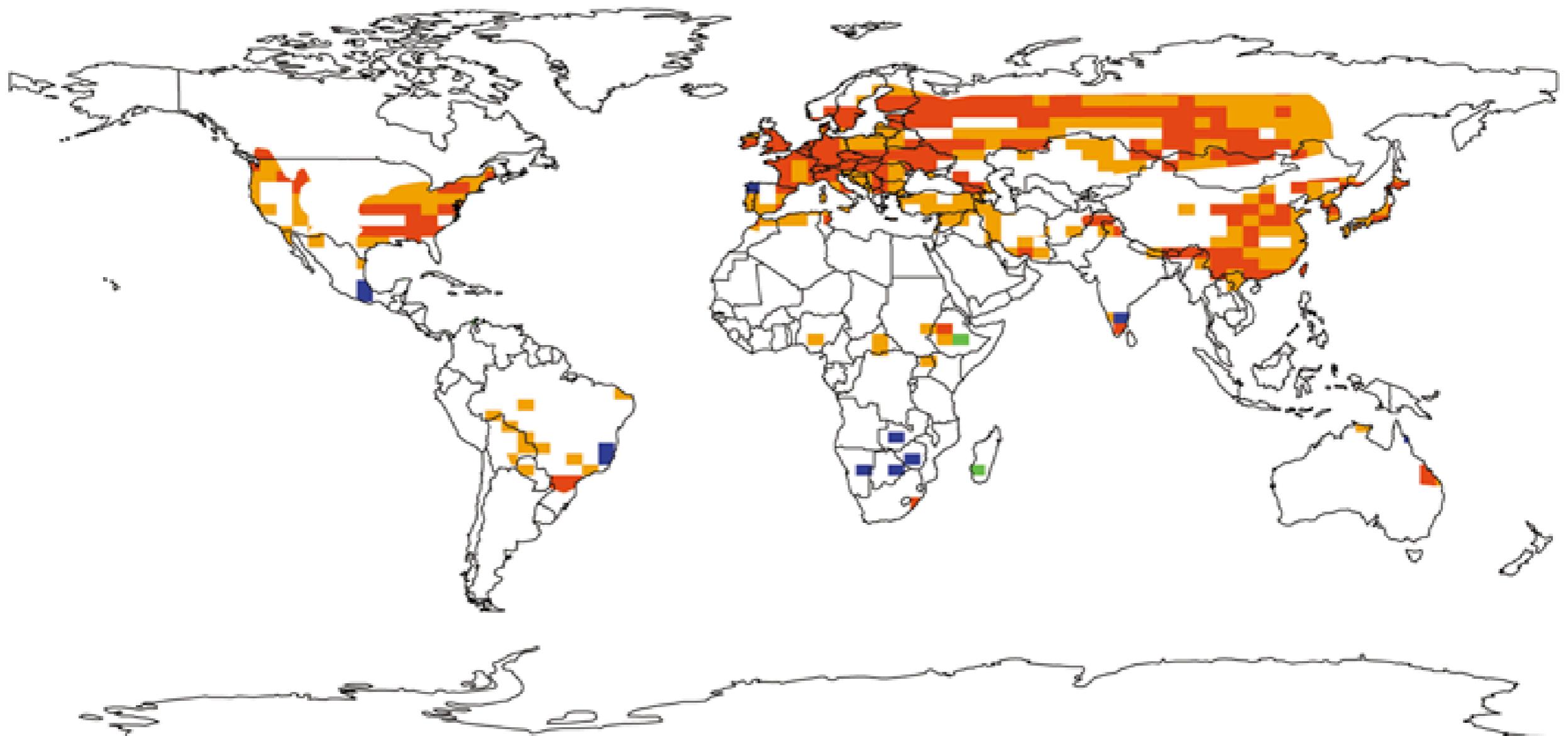
Changes in Crop Yield

from the present day to 2080s

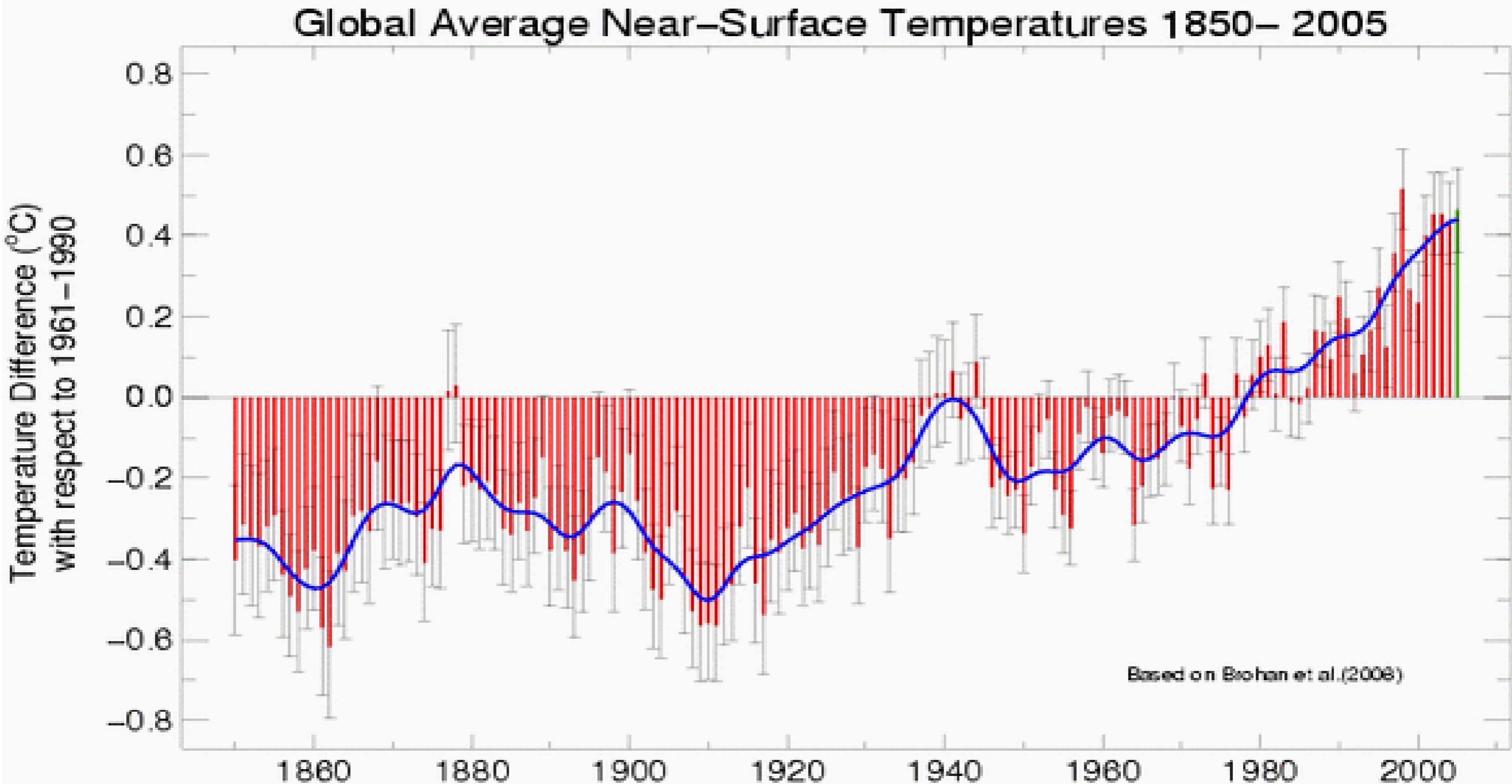


Malaria Transmission Season

change in duration by the 2080s

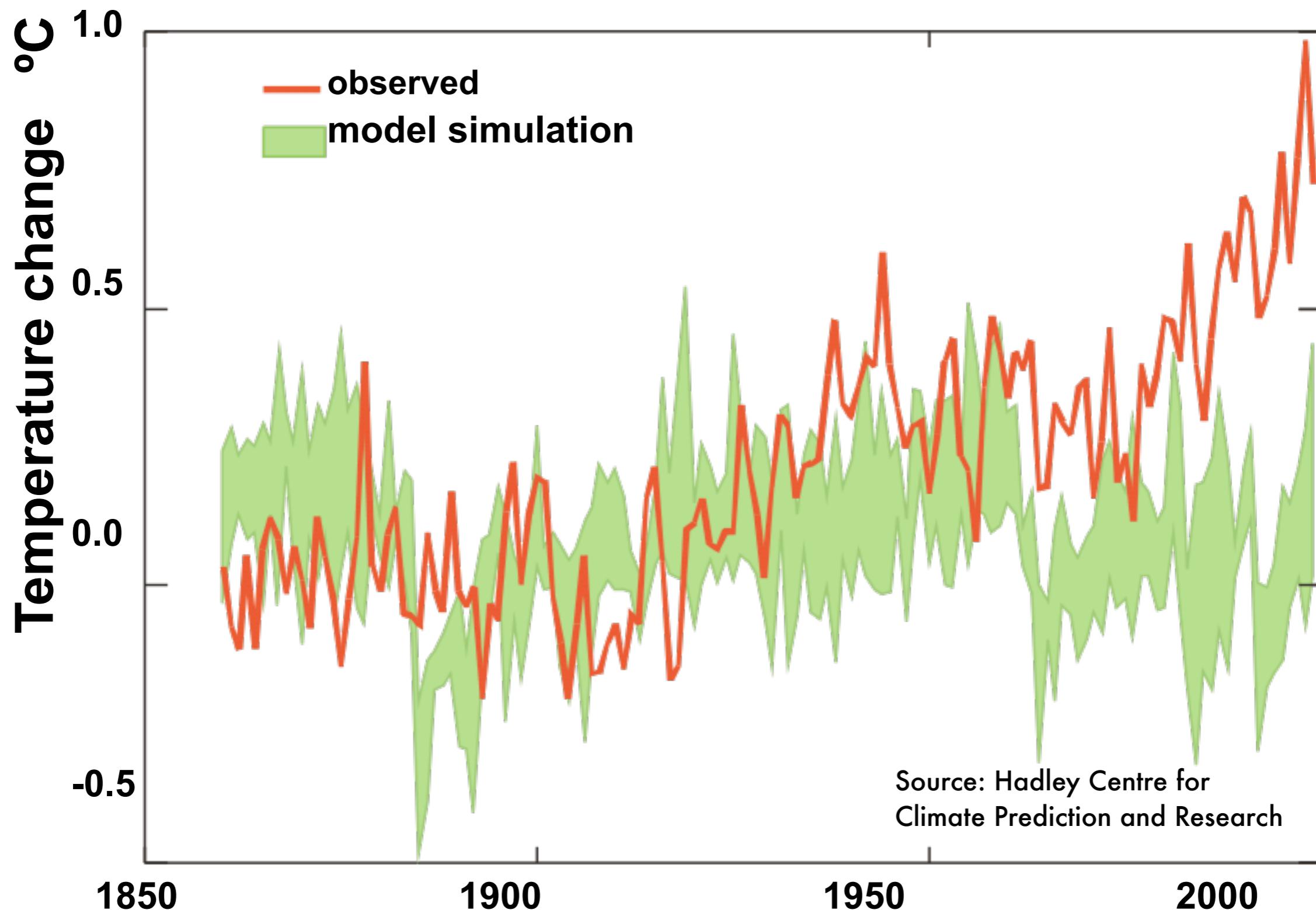


What Has Happened...

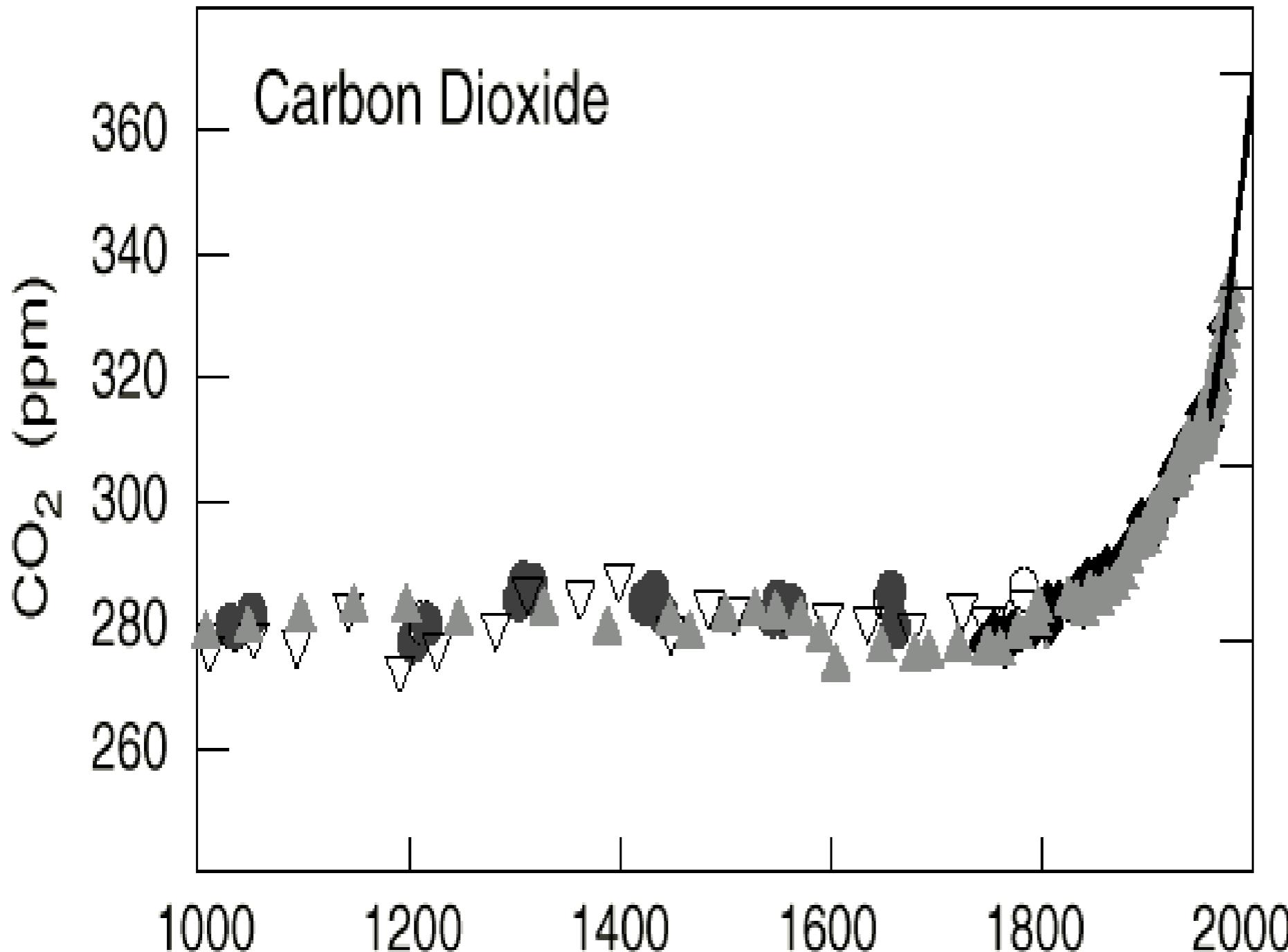


Observed and Simulated Change

Natural Factors Only



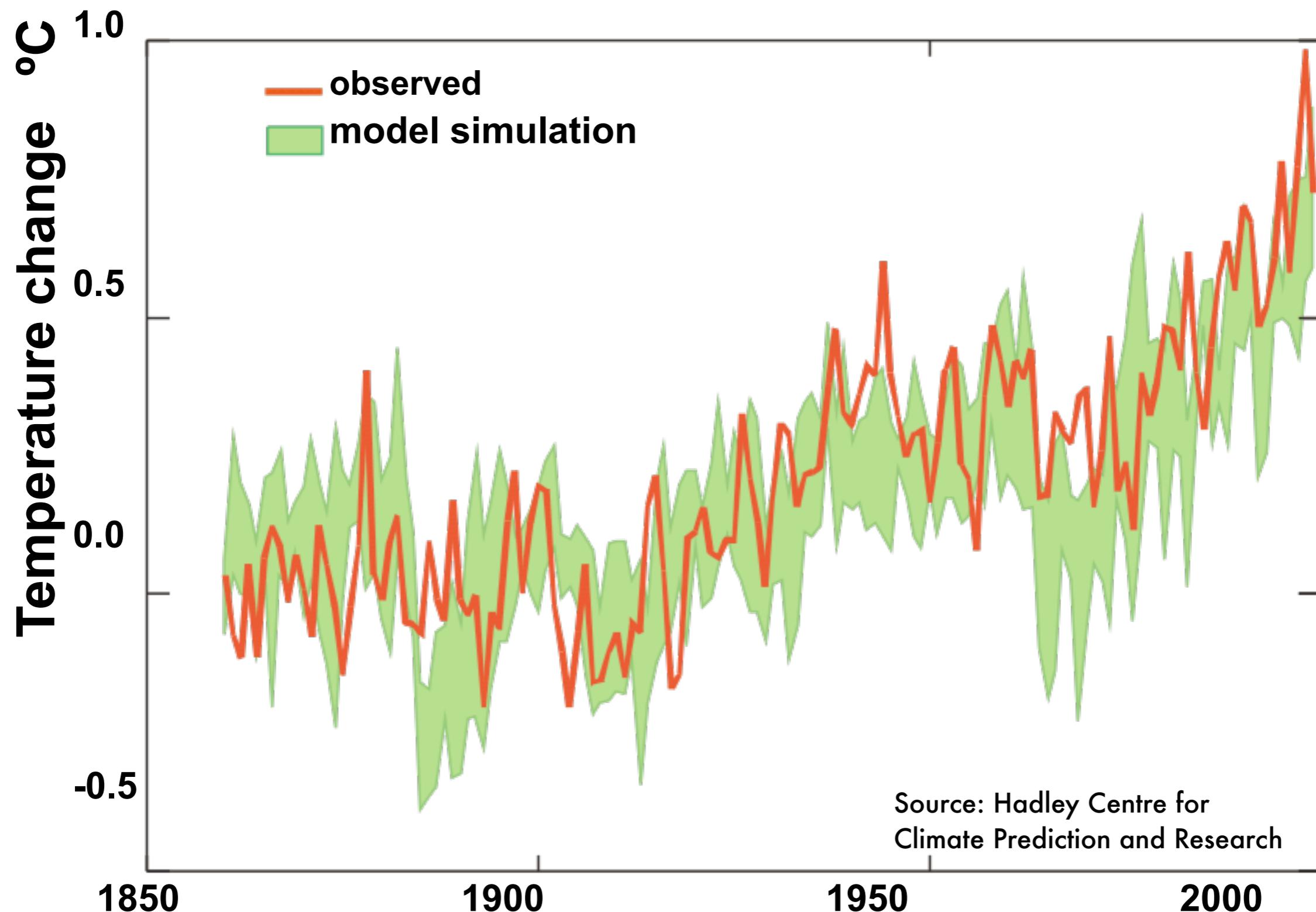
Carbon Dioxide in the Atmosphere



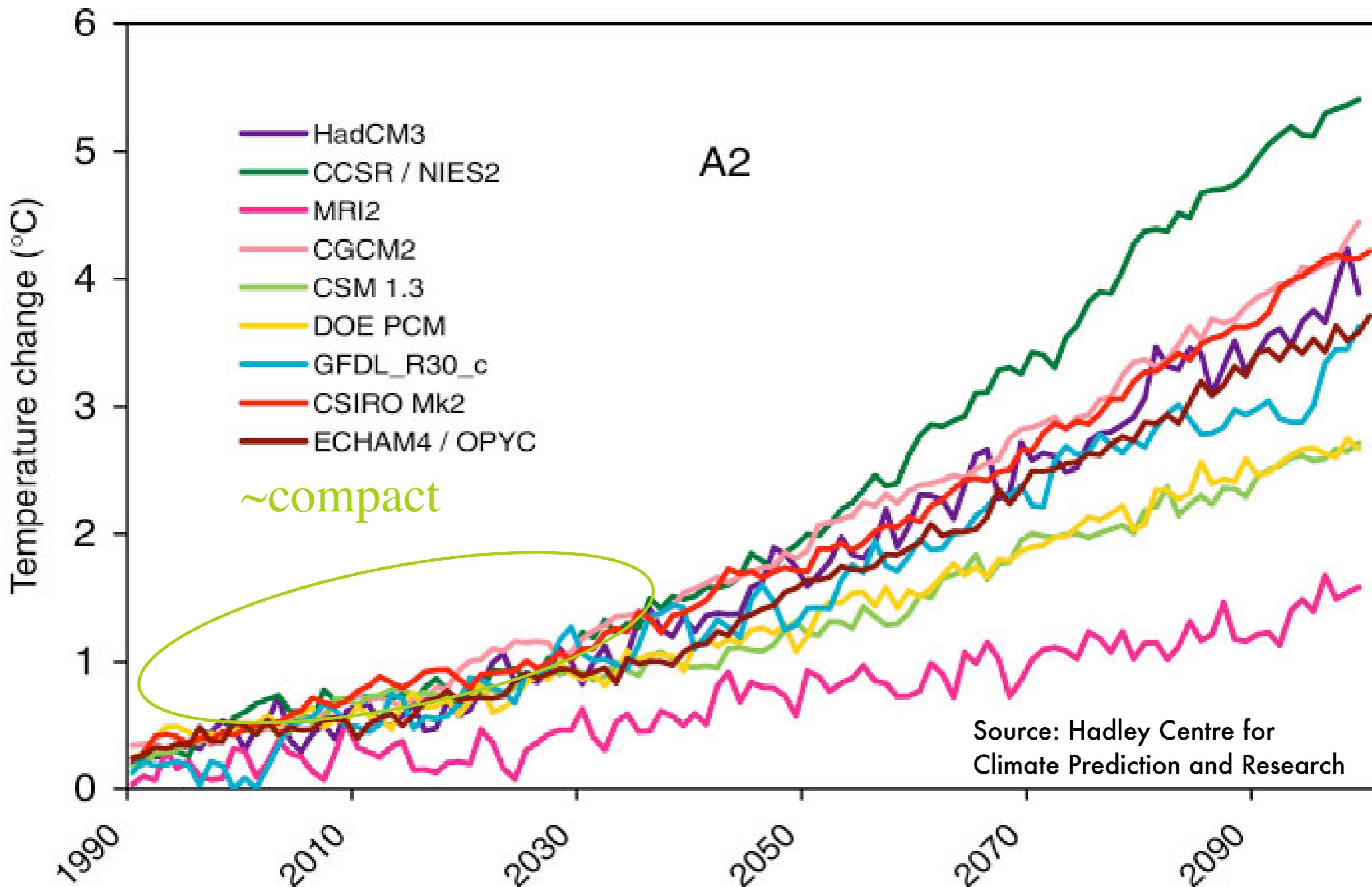
Source: Hadley Centre for
Climate Prediction and Research

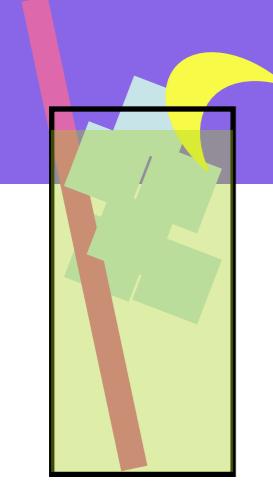
Observed and Simulated Change

Natural AND Man-Made Factors



Cautionary note: Global Temperature Rise for the same emission scenario, predicted by 9 climate models

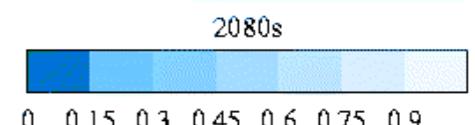
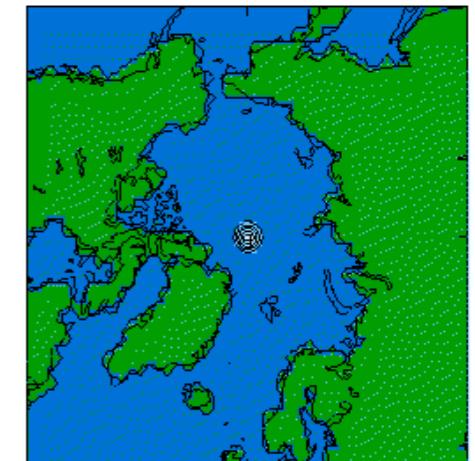
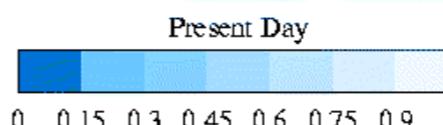
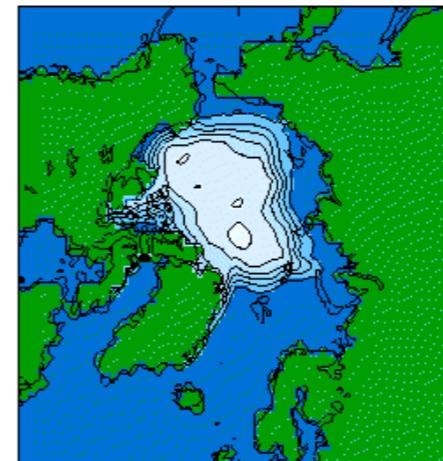




Sea level changes

Decline in floating sea ice has little impact on sea level....

Arctic summer sea ice



Source: Hadley Centre for Climate Prediction and Research

1900

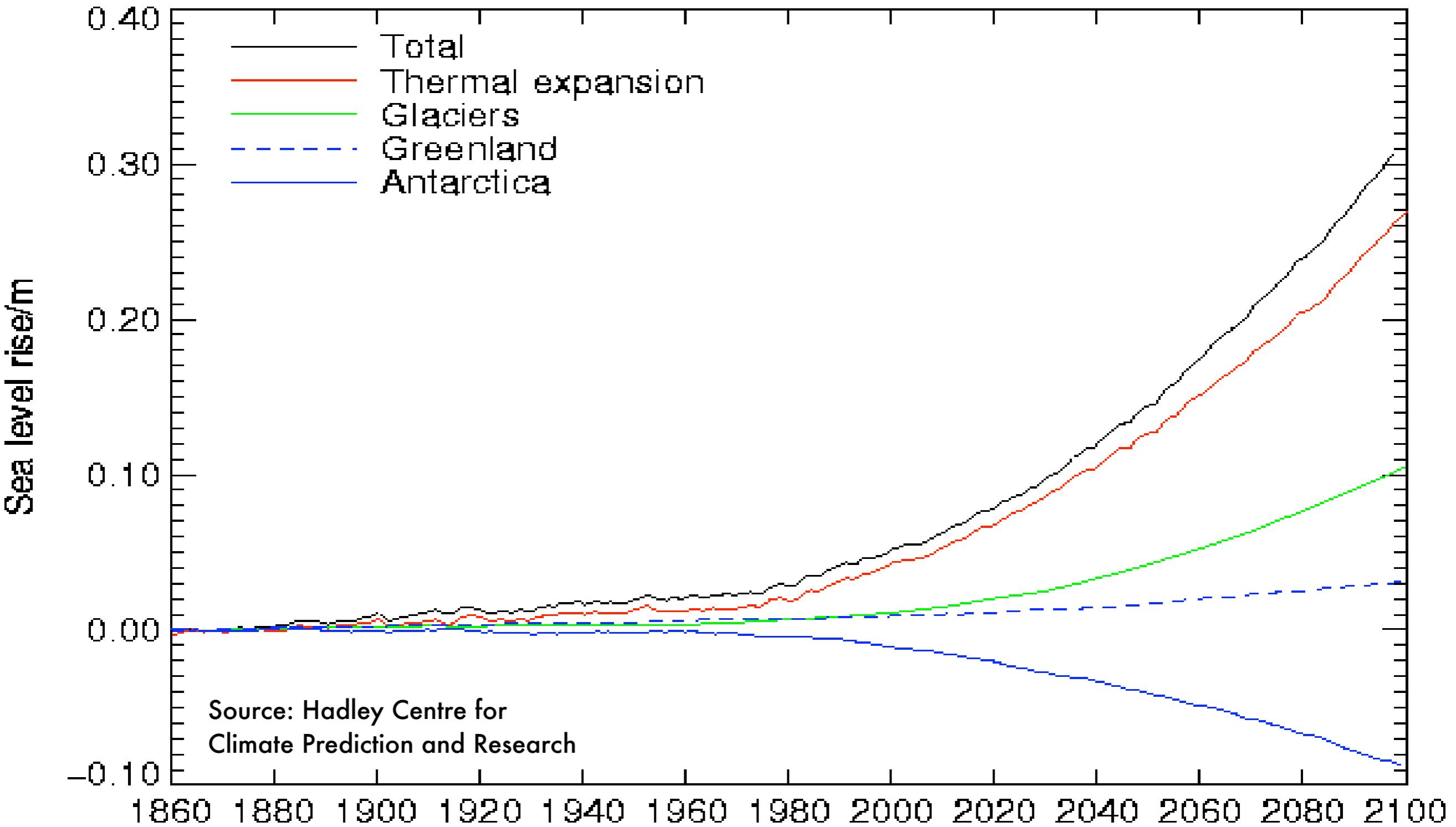


2000



Melting
glaciers do...

Why Does the Sea Level Change?

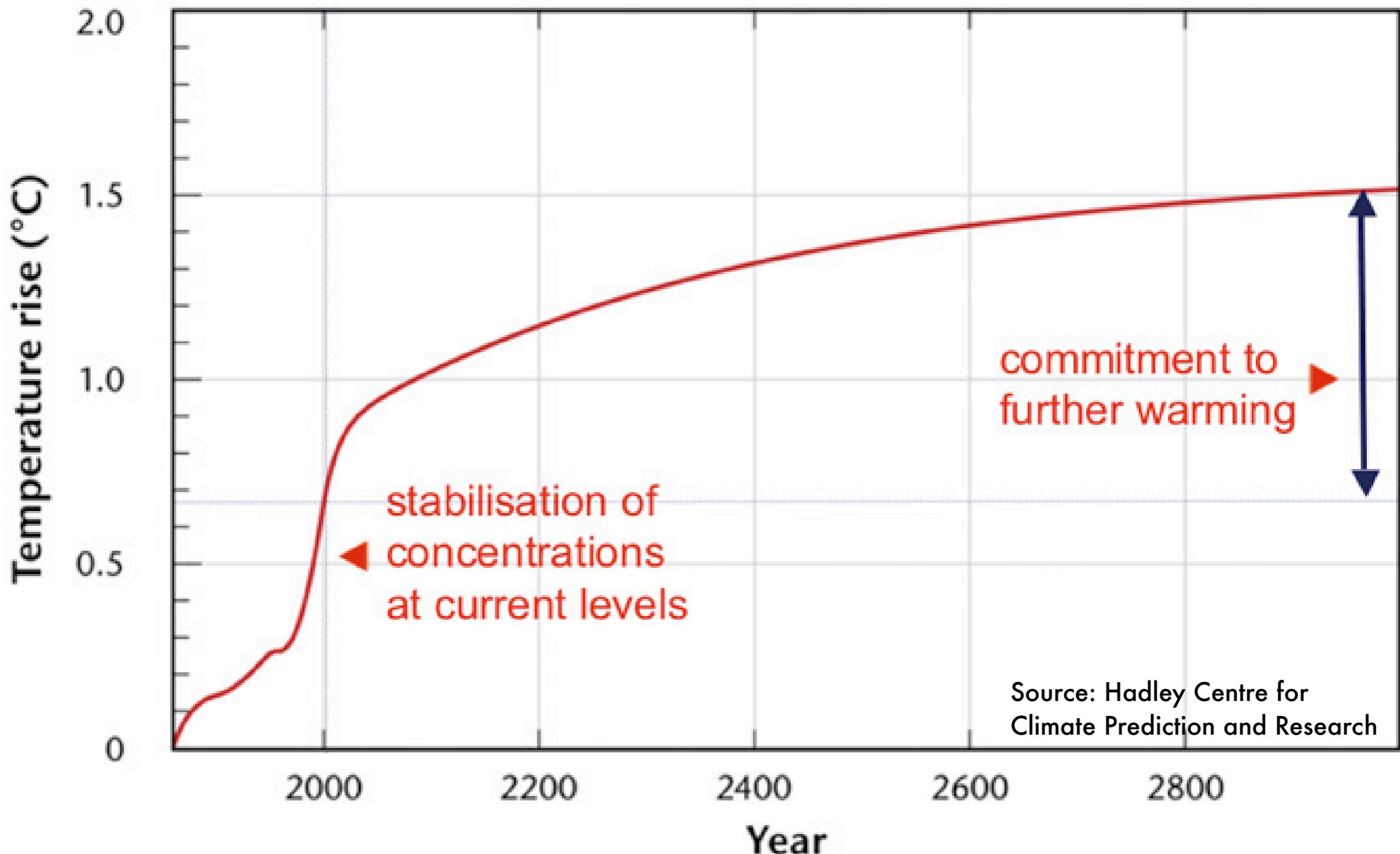


Commitments

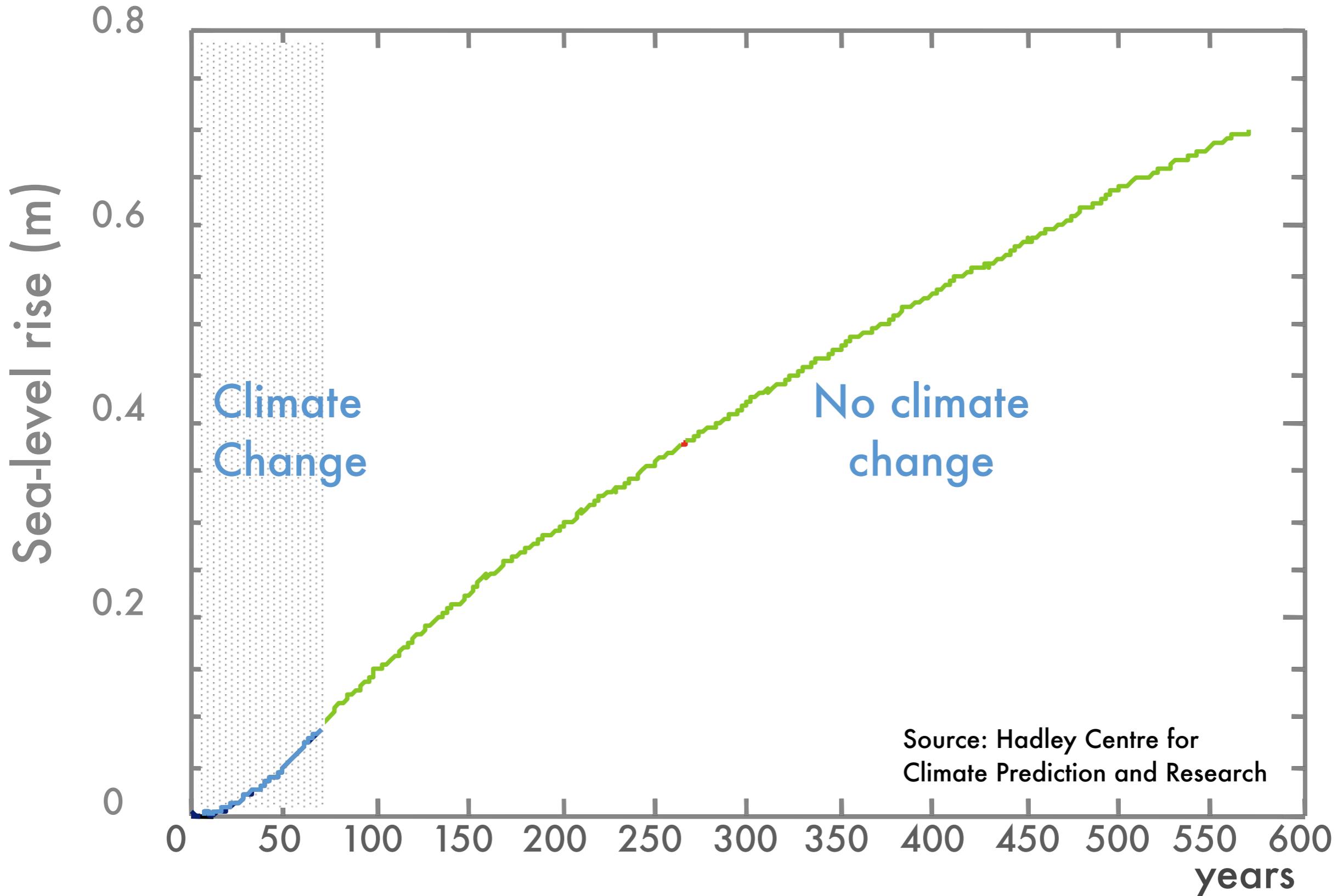
What if we could stabilise CO₂?

- Temperature rise.....
- Sea level rise.....

Temperature Rise Commitment



Sea Level Rise Commitment





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ImpEE is based at the Department of Engineering at the University of Cambridge and is funded by the CMI Institute.