

# THE ImpEE PROJECT

IMPROVING  
ENGINEERING  
EDUCATION

## Climate Change and Sustainability



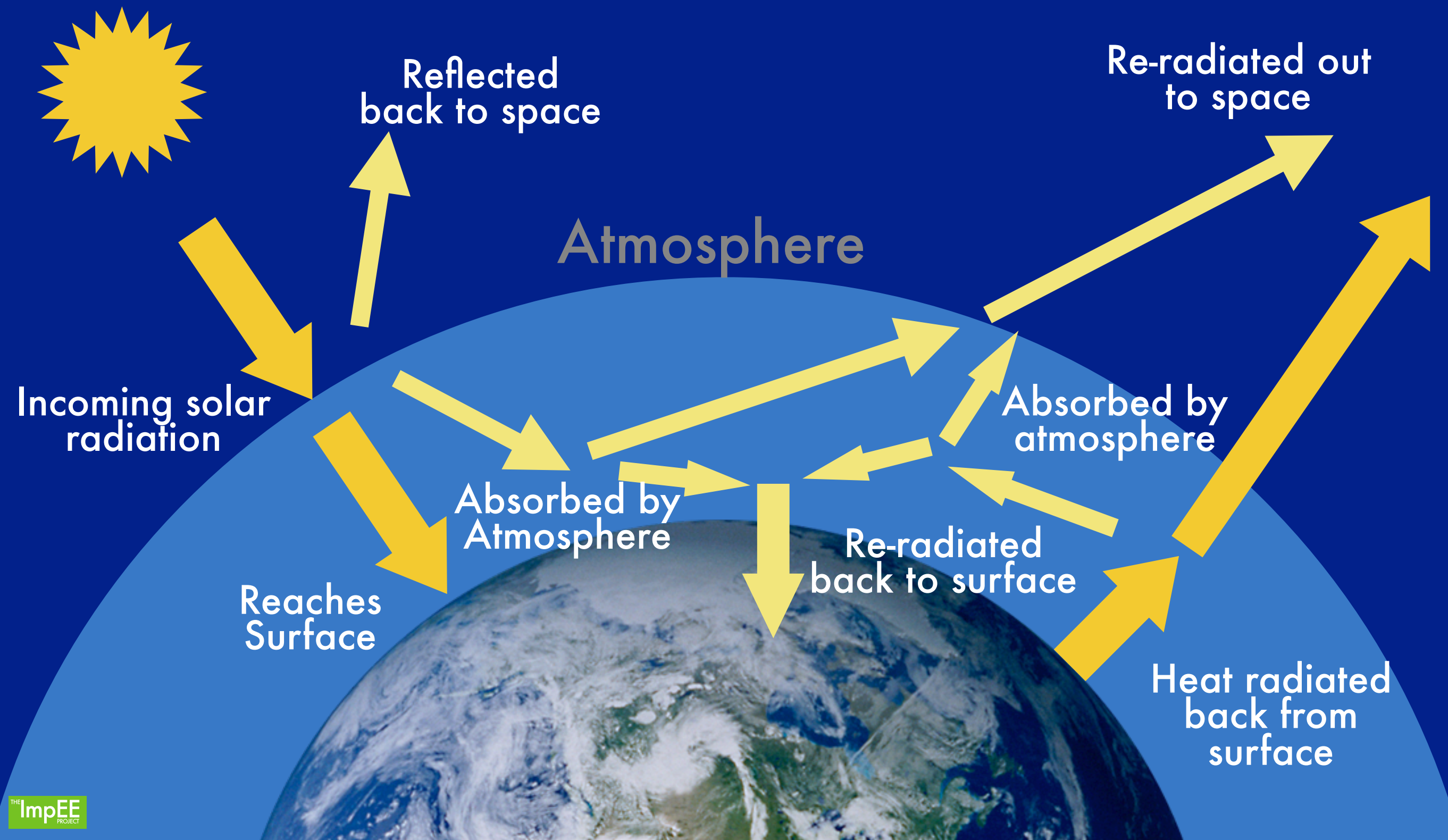
The  
Cambridge-MIT  
Institute



UNIVERSITY OF  
CAMBRIDGE



# The Greenhouse Effect



# Greenhouse Gases

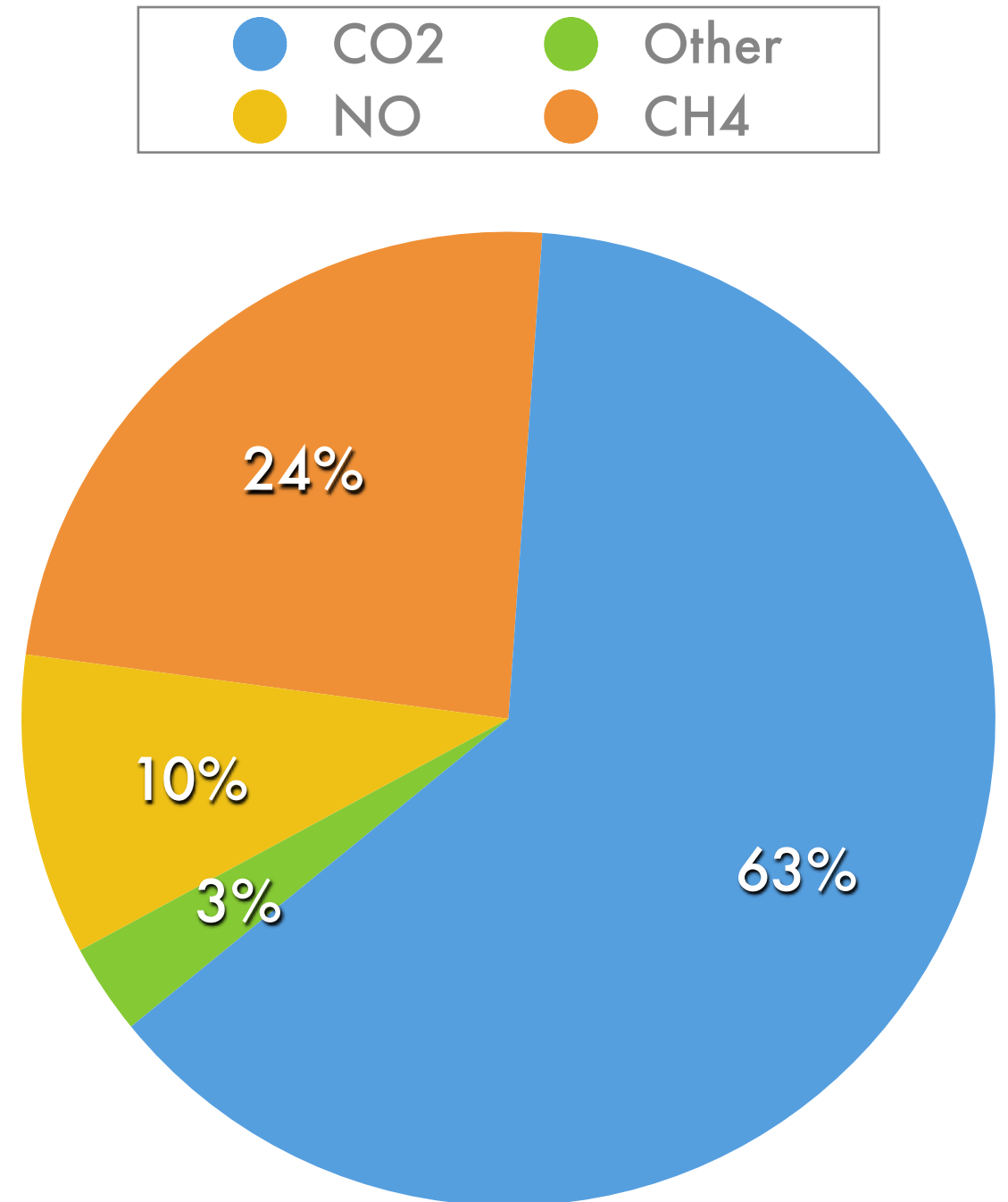
The most talked about factors contributing to Global warming are Greenhouse Gases (GHG)

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

# CO<sub>2</sub> 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

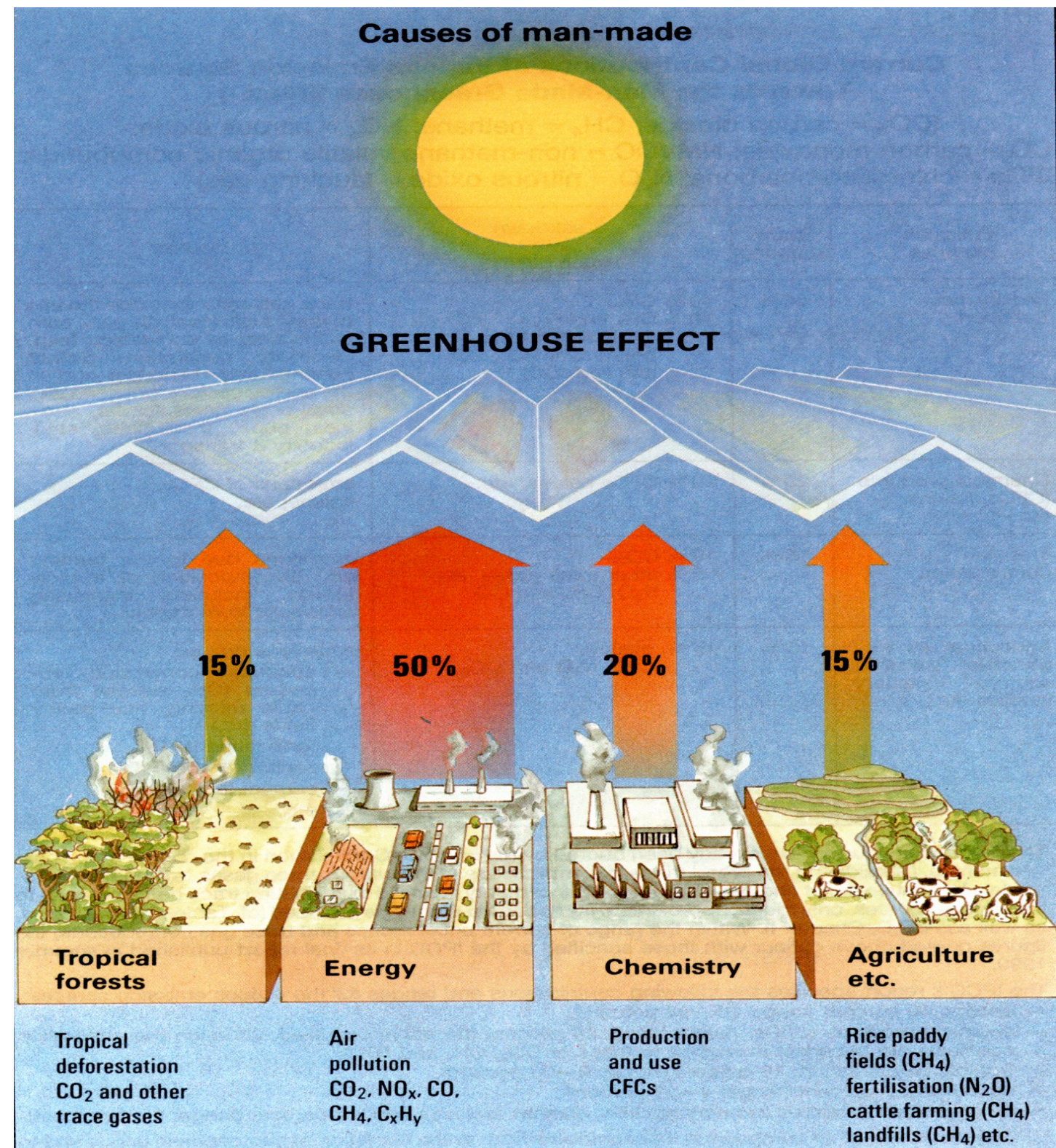




# Sources and Lifetimes of Greenhouse Gases

- Carbon Dioxide (CO<sub>2</sub>): 100 years
- Methane: 10 years
- Nitrous Oxide: 150 years
- Chlorofluorocarbons: 100 years

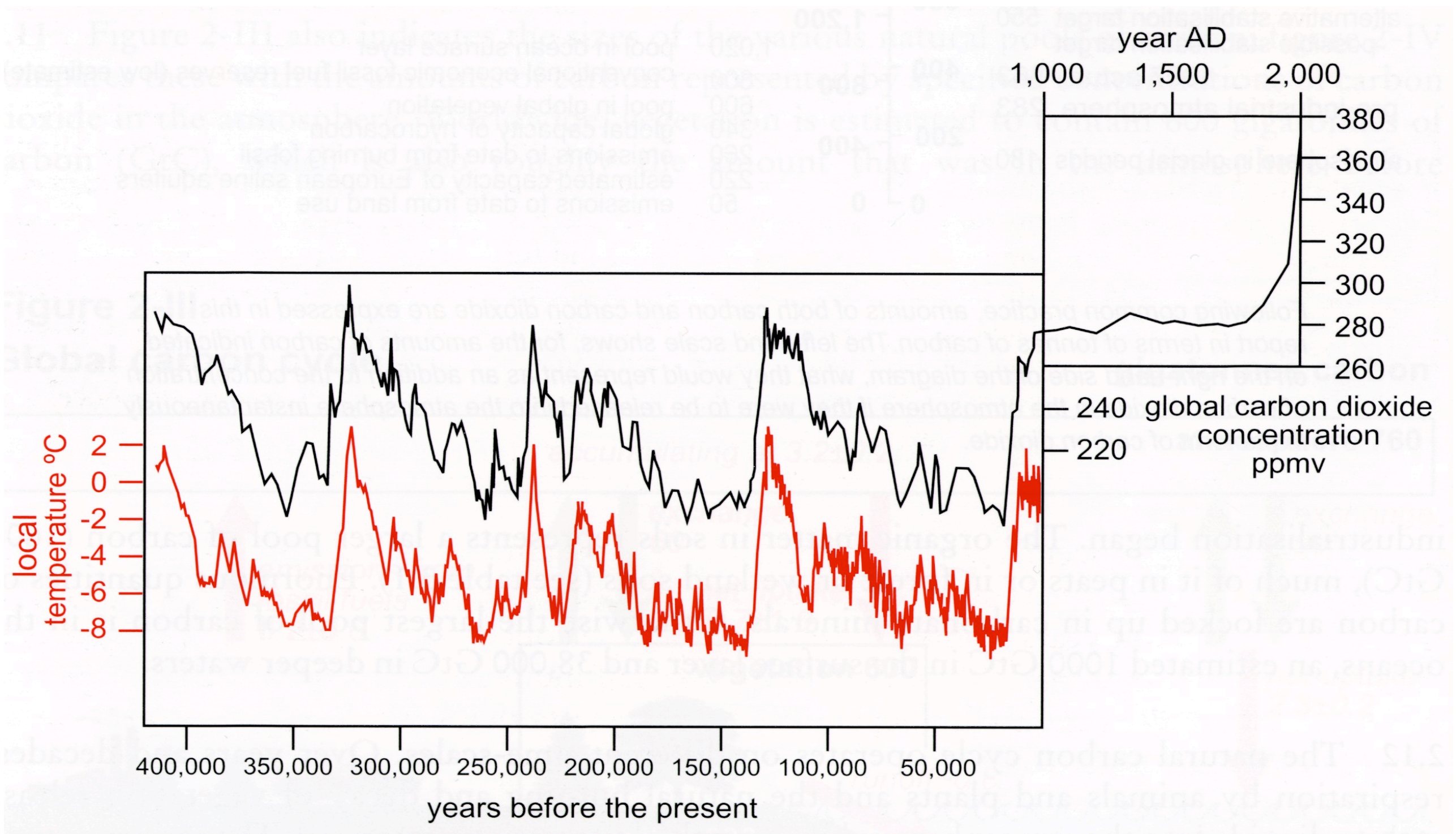
(Source: Hadley Centre for Climate Prediction and Research)



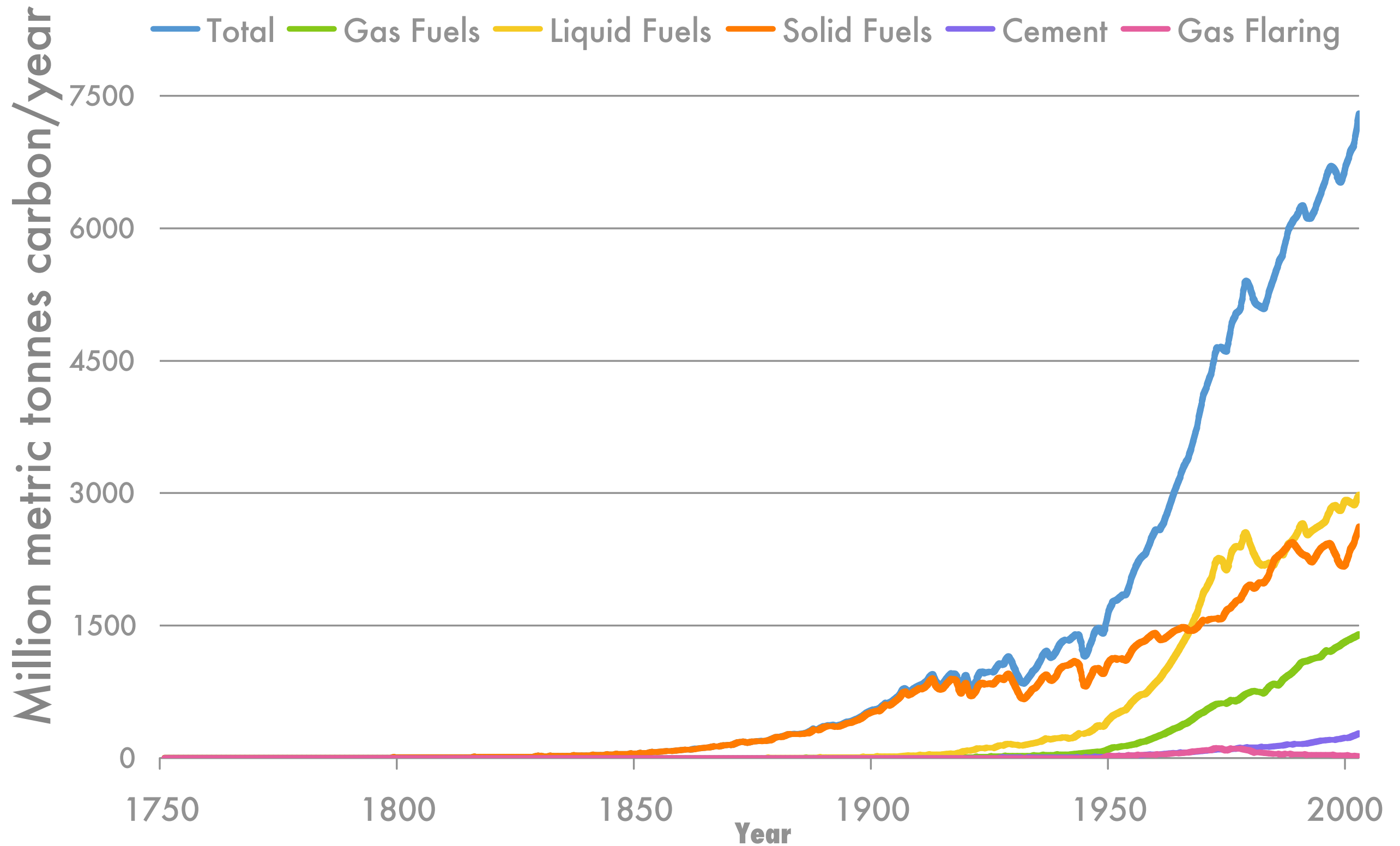


# Evidence for the Impact of CO<sub>2</sub>

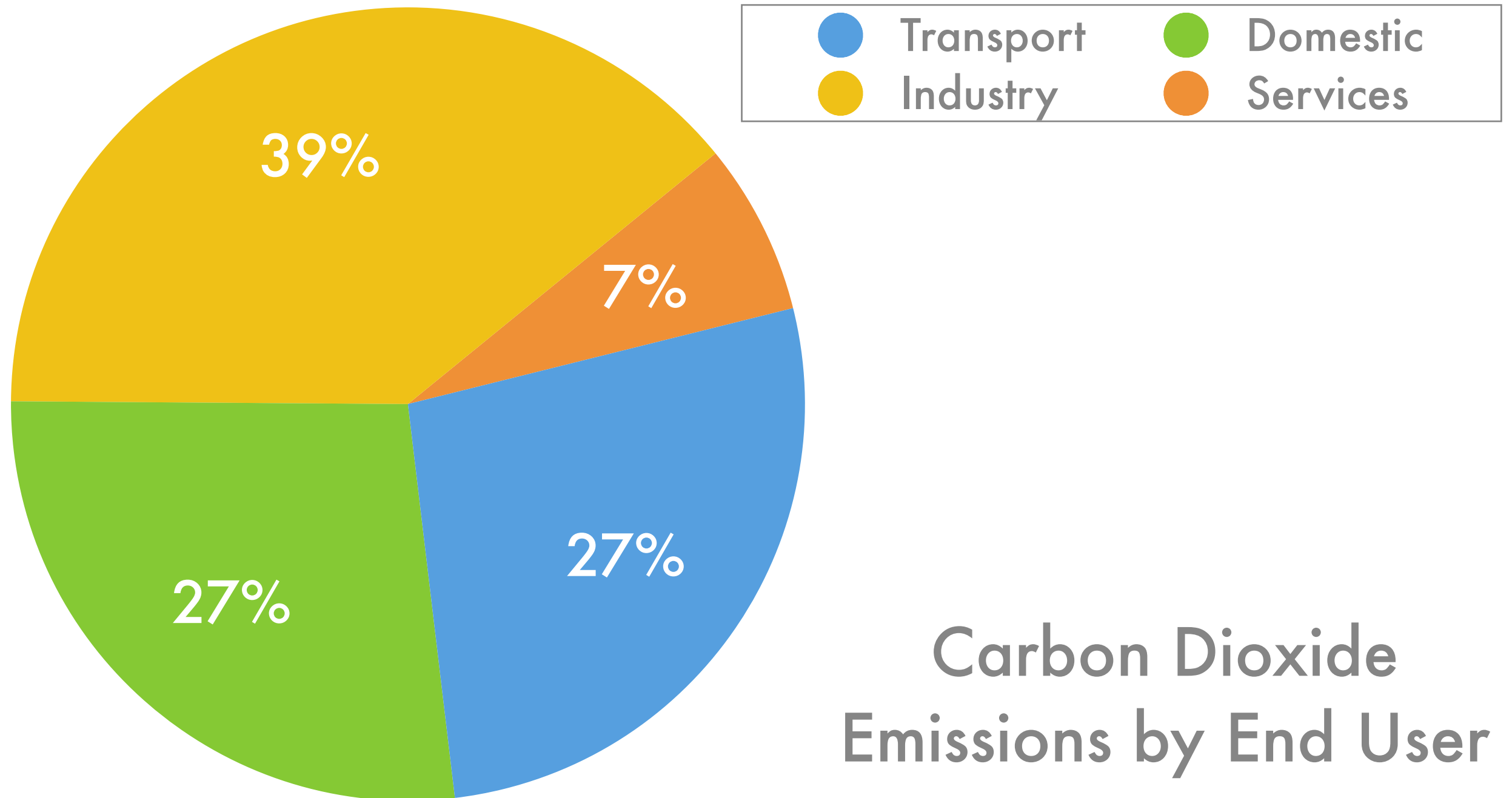
## Vostok Ice-Core and Temperature graph



# Anthropogenic CO<sub>2</sub> Forcings

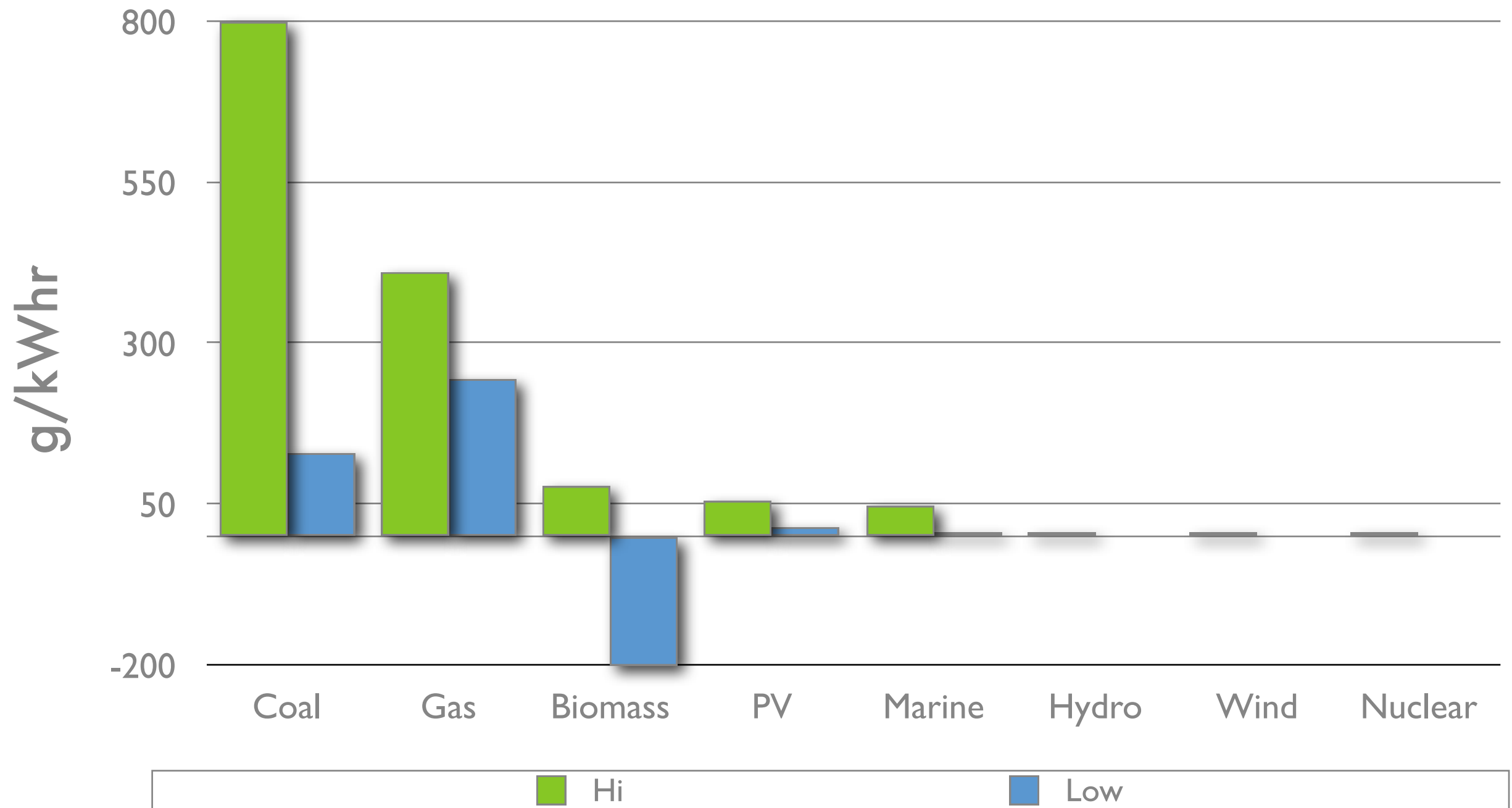


# Carbon Dioxide Emissions





# CO<sub>2</sub> Emissions from Fossil Fuels

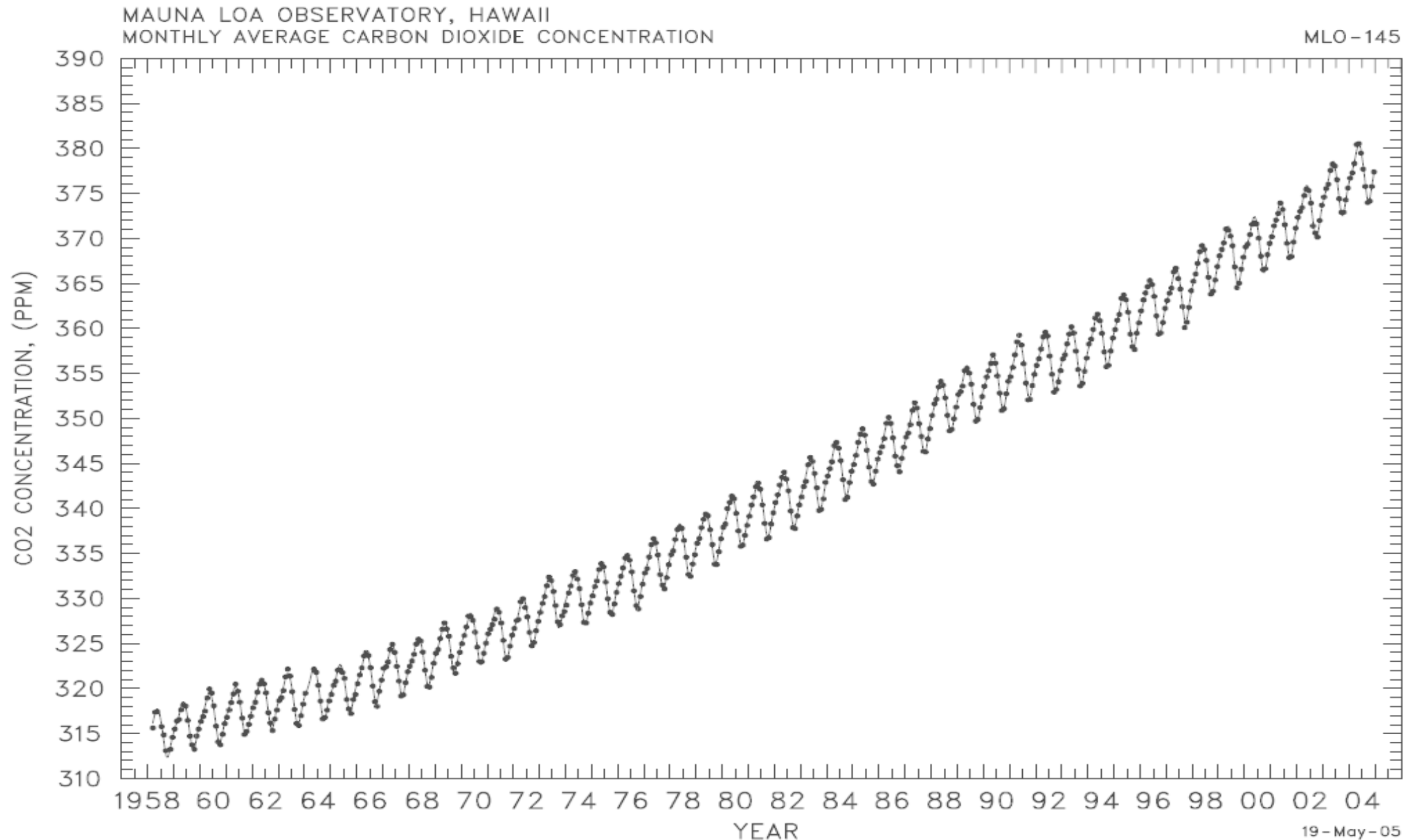


Comparison of high and low lifetime carbon emissions for all technologies  
(grams of carbon dioxide per kilowatt hour)

# Other Anthropogenic Forcings

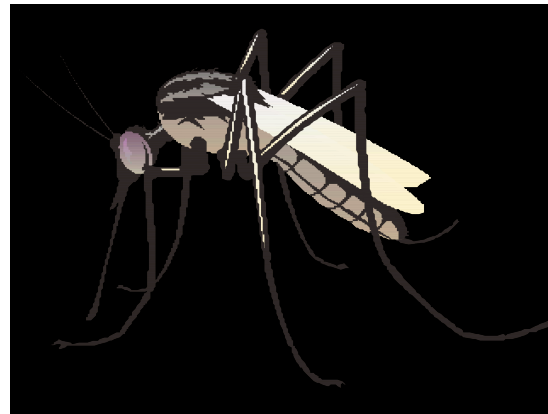
Although CO<sub>2</sub> **emissions** are important, the disturbance of natural CO<sub>2</sub> **sinks** such as forests and soils also affects the overall concentration of CO<sub>2</sub> in the atmosphere

# CO<sub>2</sub> Concentrations in the Atmosphere (*measured at Mauna Loa, Hawaii*)



# Impacts of Climate Change

- Health risks
- Decreased agricultural productivity
- Increased storminess





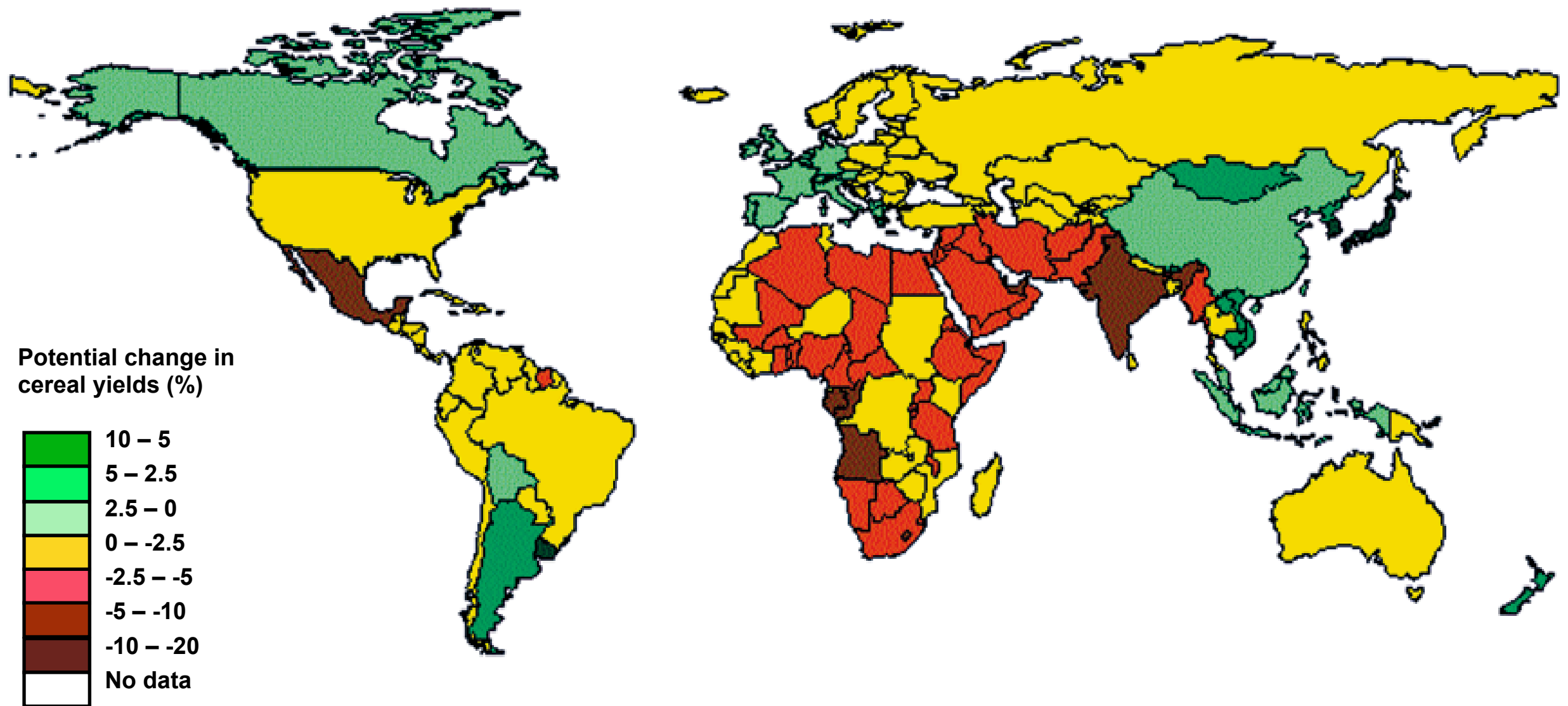
# Impacts of Climate Change

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



# Changes in Crop Yield

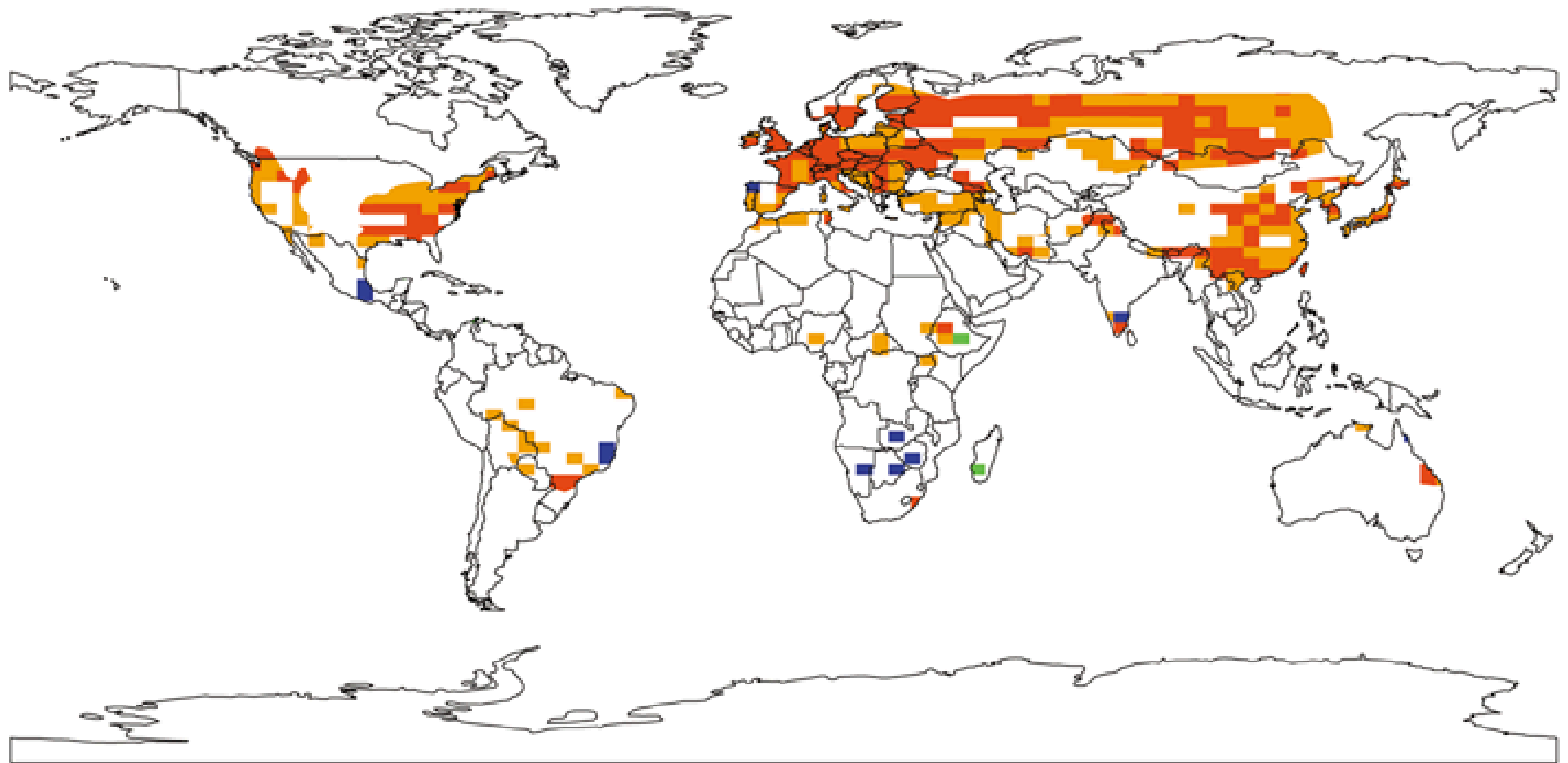
*from the present day to 2080s*



University of  
East Anglia

# Malaria Transmission Season

*change in duration by the 2080s*



2 to 5 months



1 to 2 months



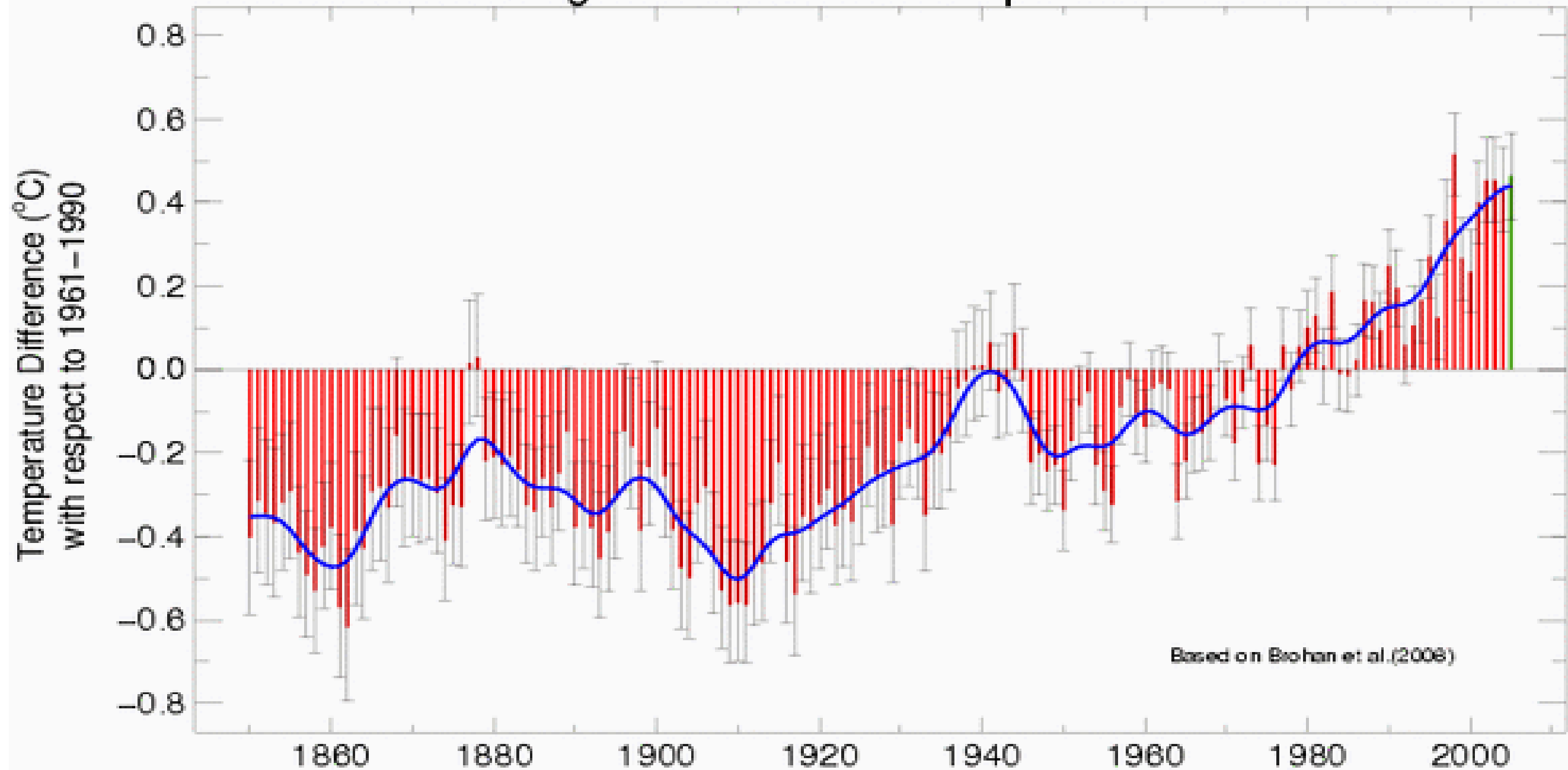
-2 to -1 months



-5 to -2 months

# What Has Happened...

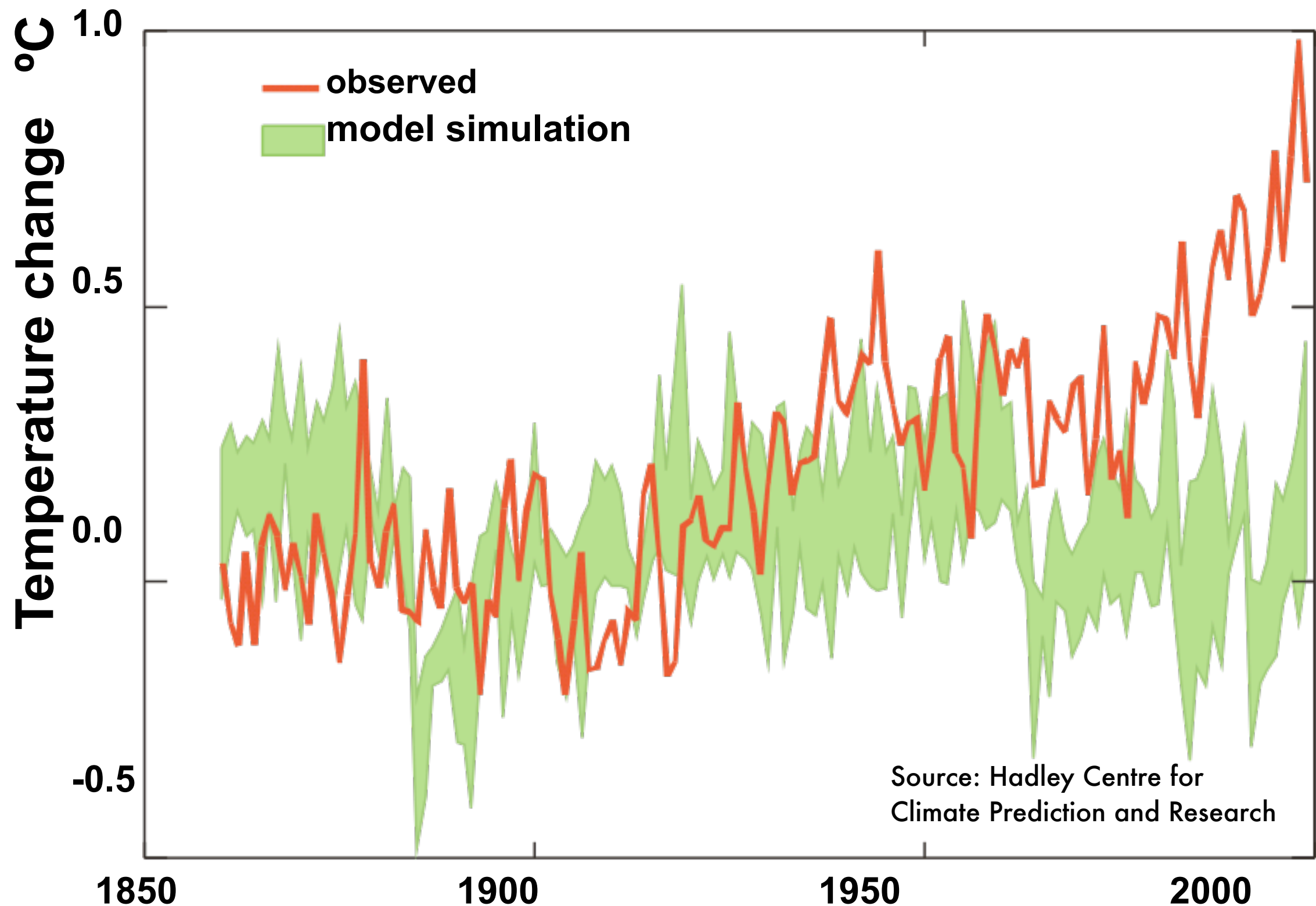
Global Average Near-Surface Temperatures 1850–2005



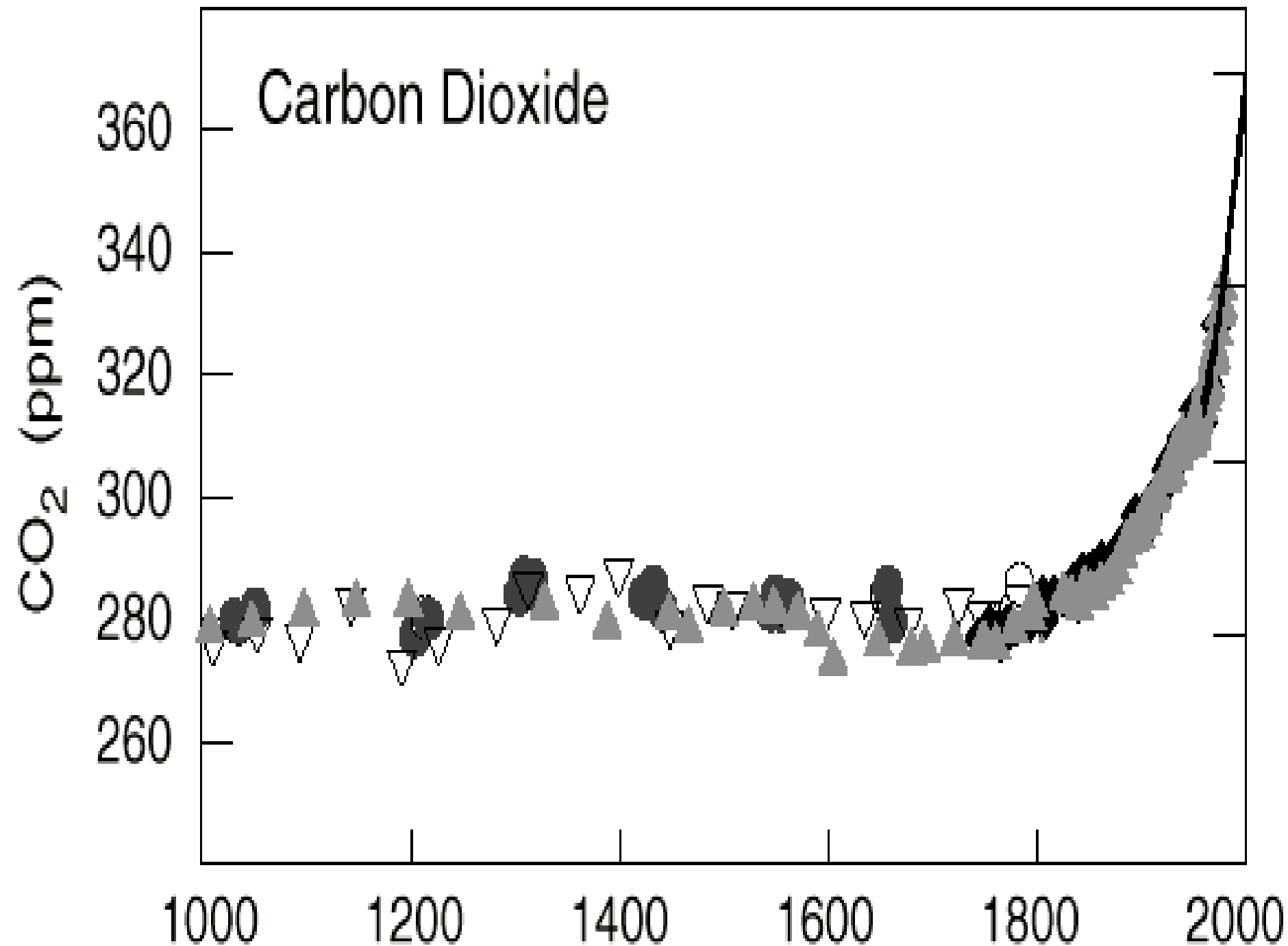


# Observed and Simulated Change

*Natural Factors Only*



# Carbon Dioxide in the Atmosphere

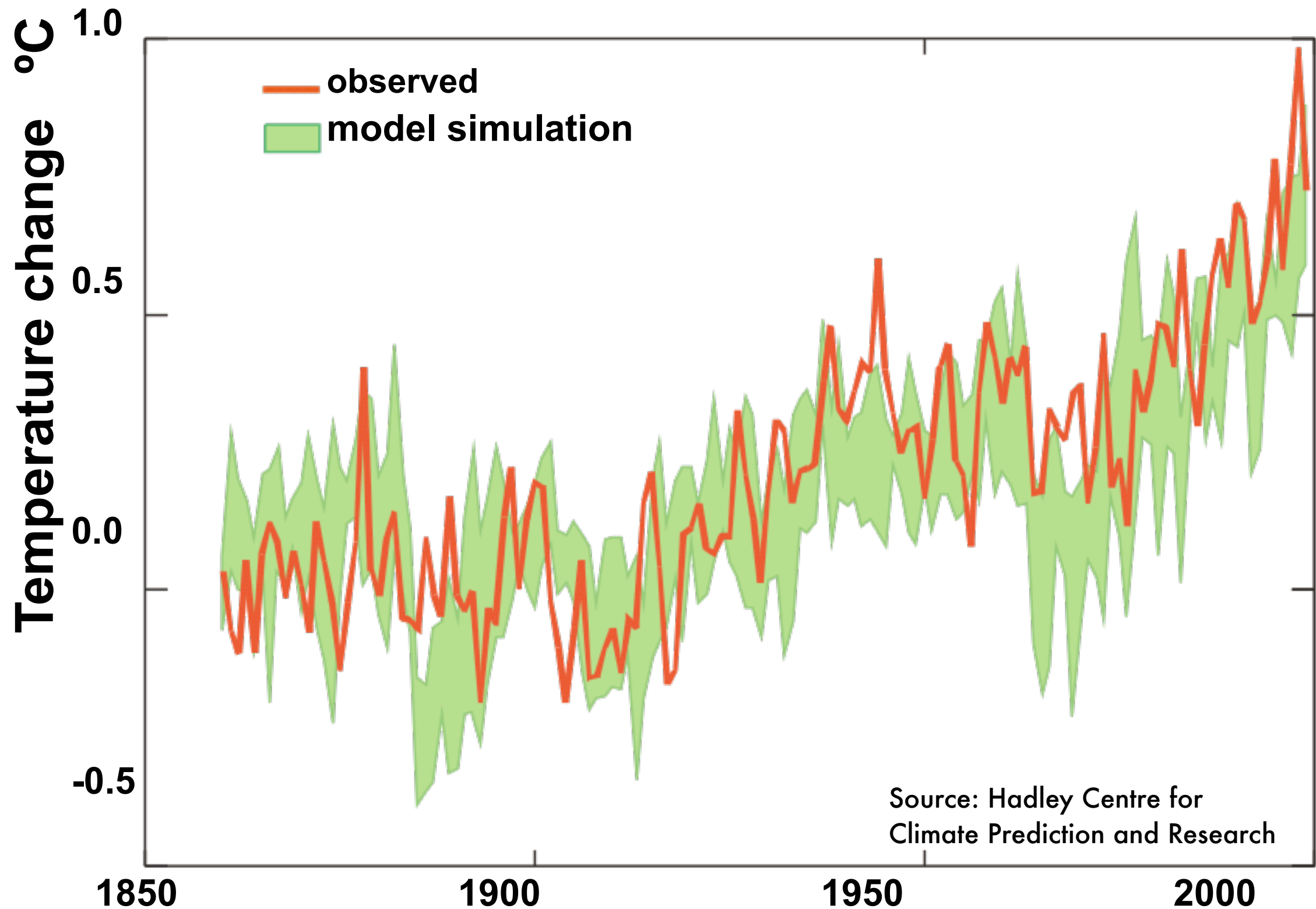


Source: Hadley Centre for  
Climate Prediction and Research



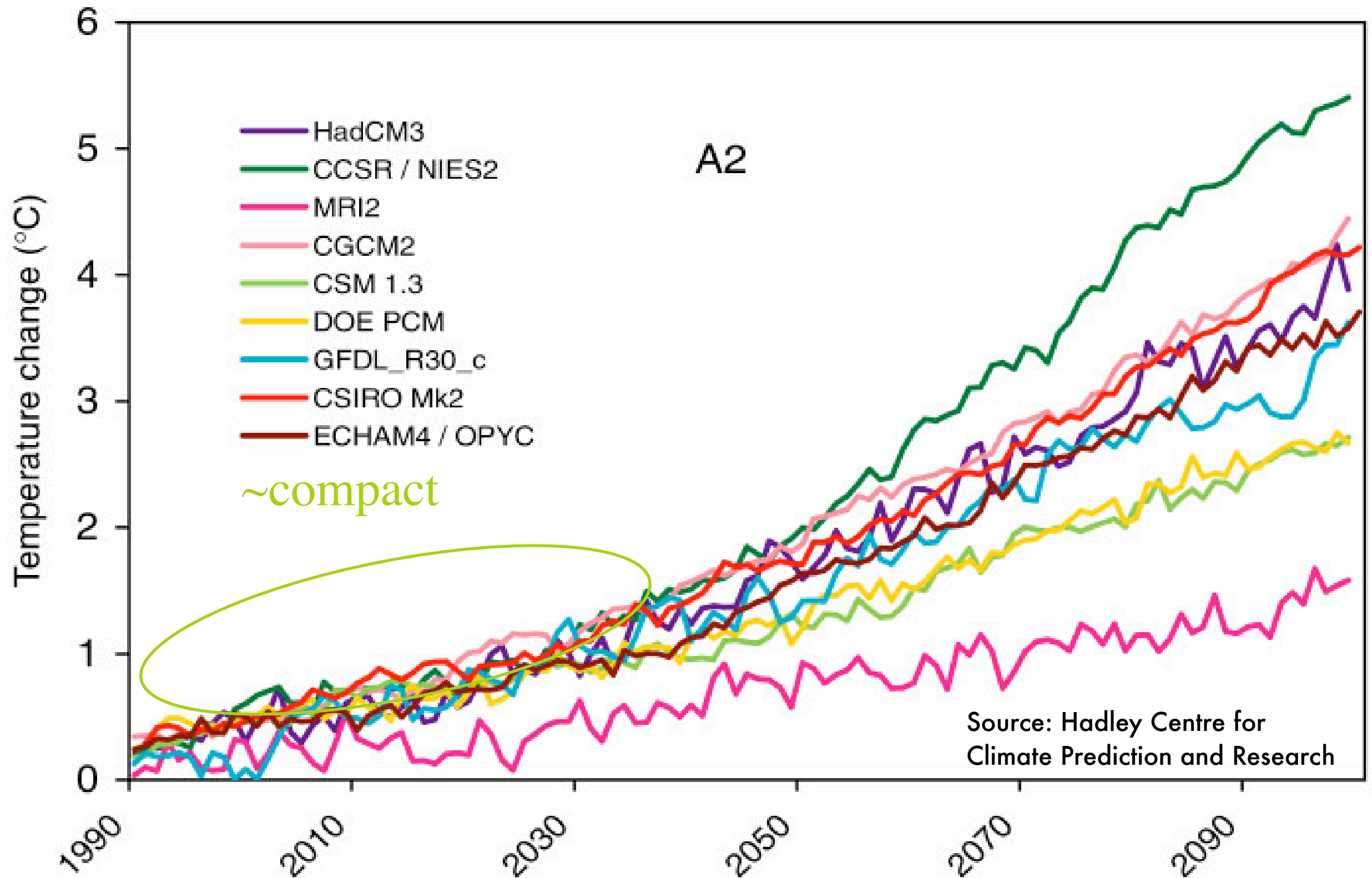
# Observed and Simulated Change

*Natural AND Man-Made Factors*



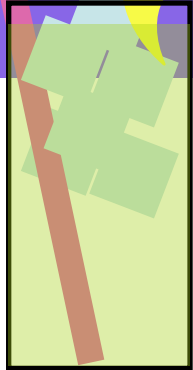
# Cautionary note: Global Temperature Rise

*for the same emission scenario, predicted by 9 climate models*



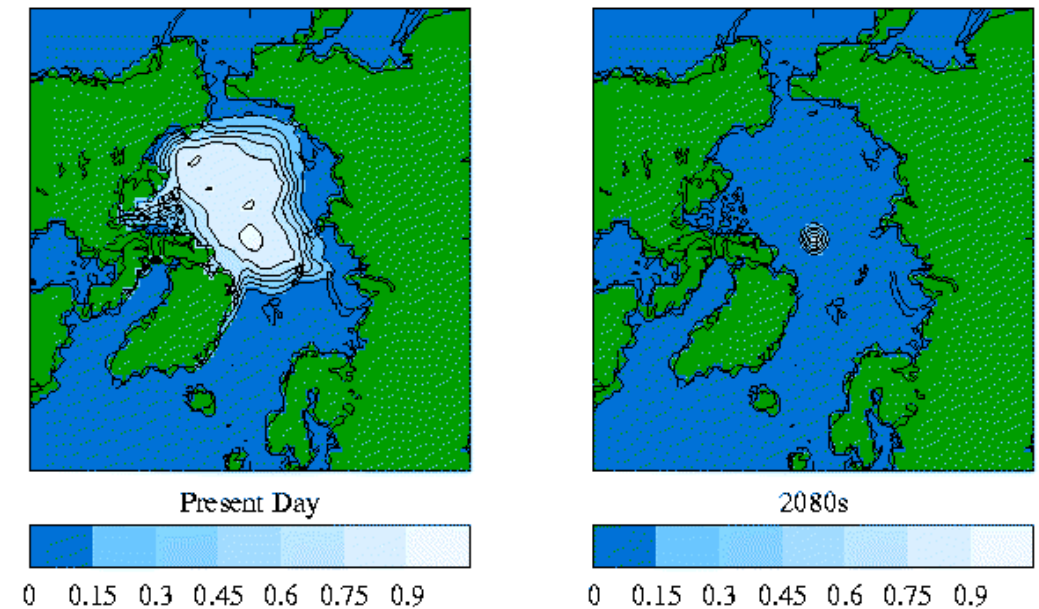


# Sea level changes



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

## Arctic summer sea ice



Source: Hadley Centre for Climate Prediction and Research

1900

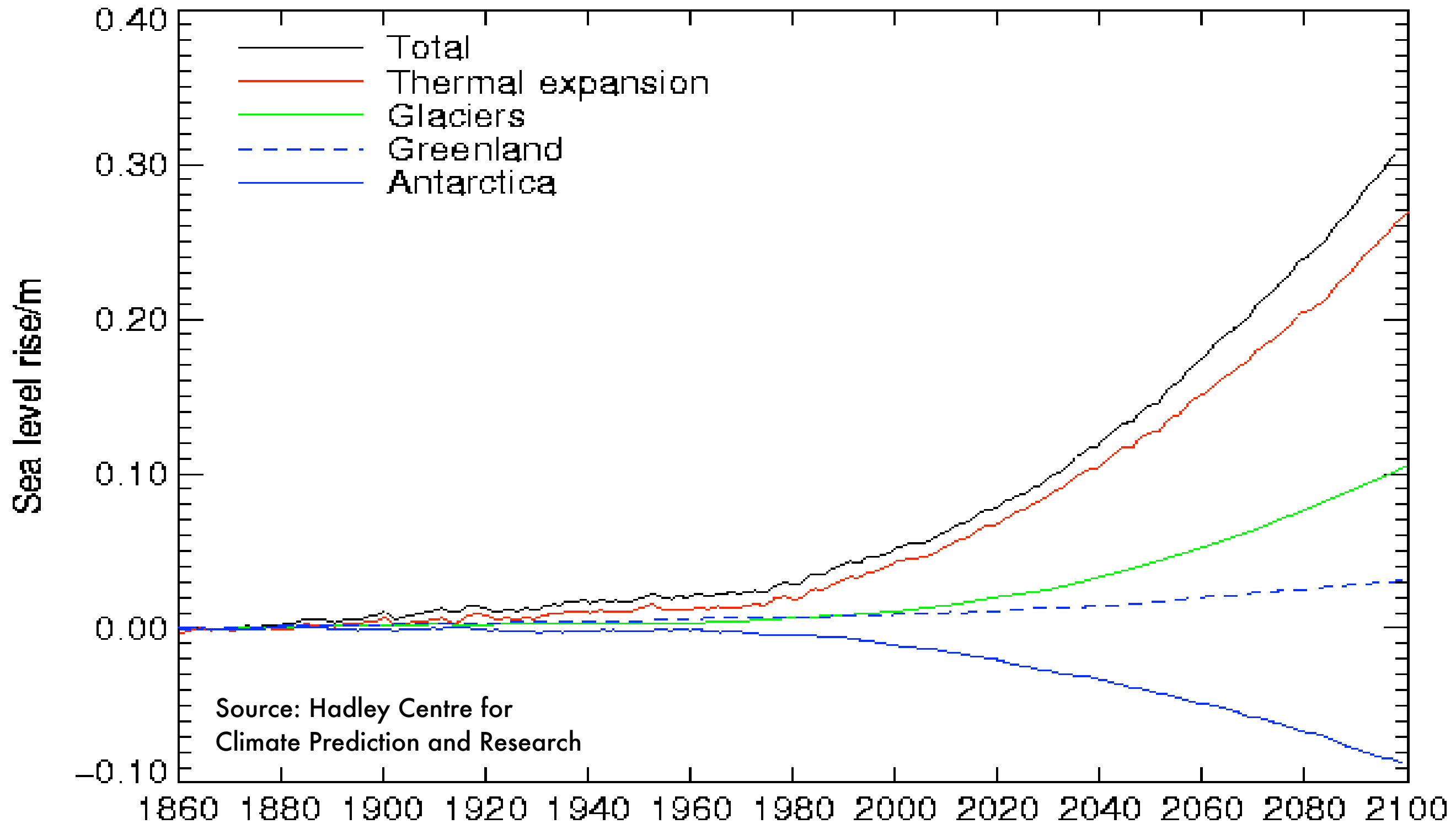


2000



Melting glaciers do...

# Why Does the Sea Level Change?

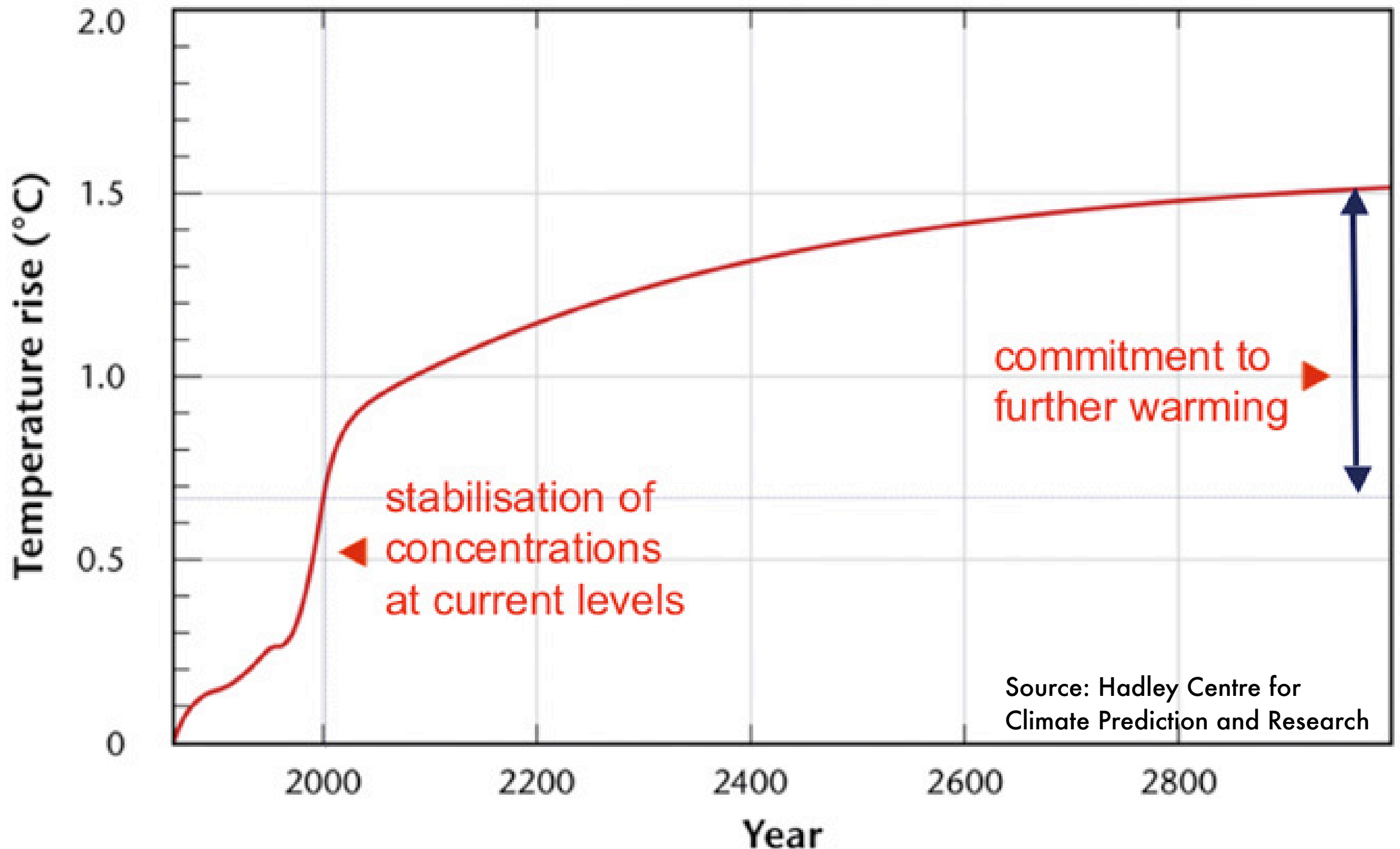


# Commitments

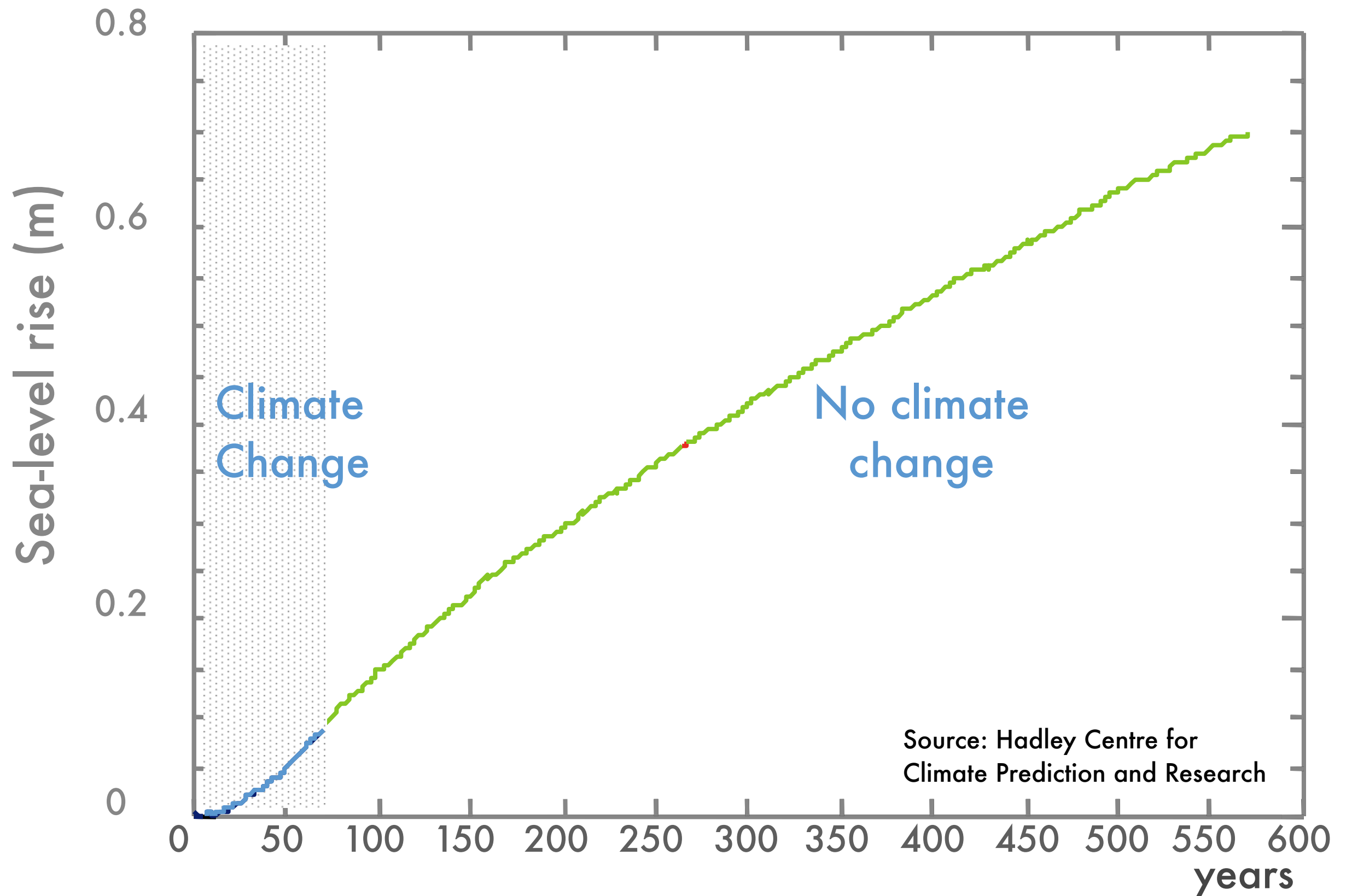
What if we could stabilise CO<sub>2</sub>?

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

# Temperature Rise Commitment



# Sea Level Rise Commitment







© University of Cambridge, 2006

This material was produced as a part of the ImpEE Project at the University of Cambridge. It may be reproduced, modified and used freely for educational purposes.



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