

# Global Warming

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## Science of global warming

- Greenhouse gases
- Other contributors

## Observed changes

- Temperature
- Other indicators

## The future

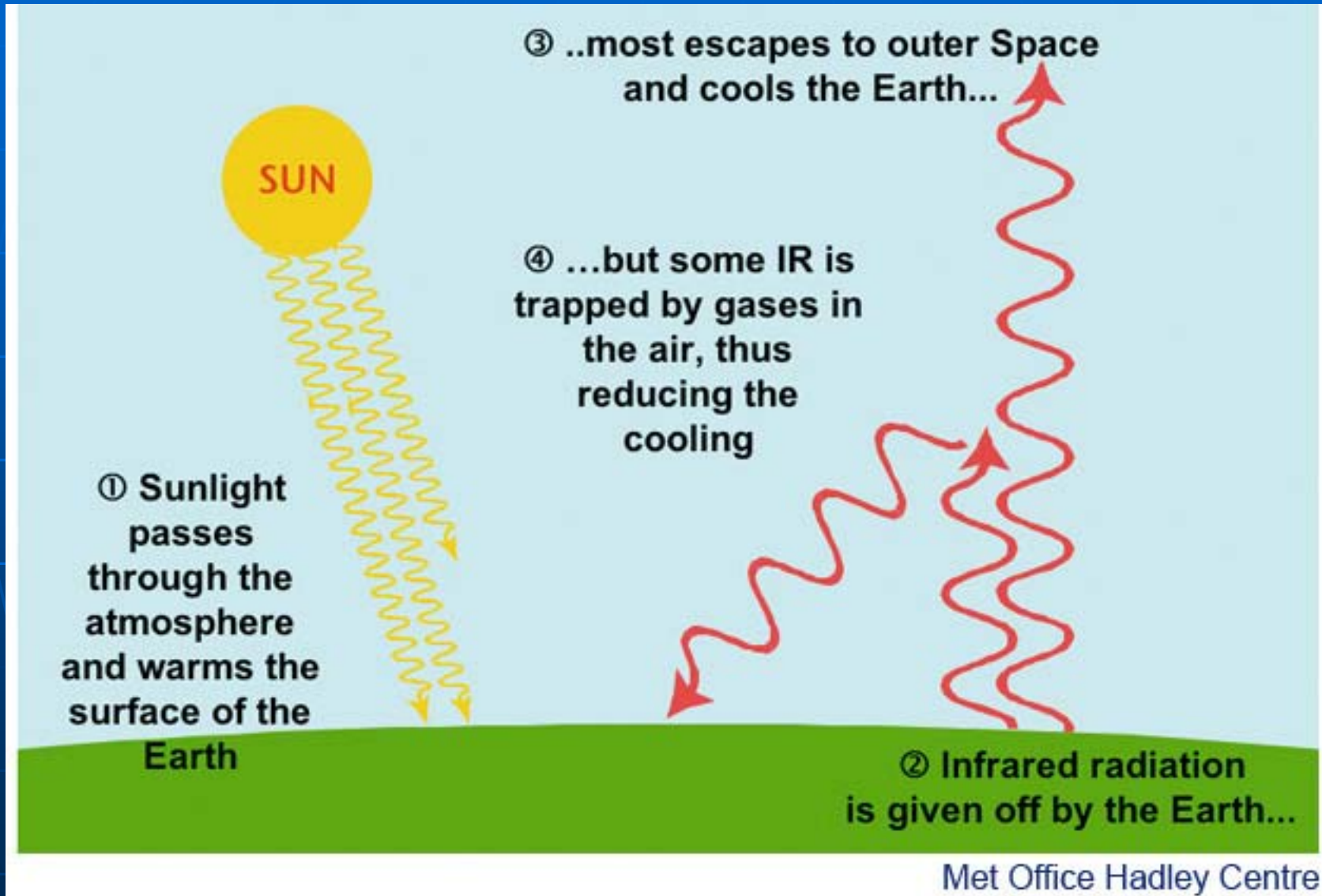
- Emissions
- Global consequences
- Consequences for California

## Mitigation Efforts

- Global
- State

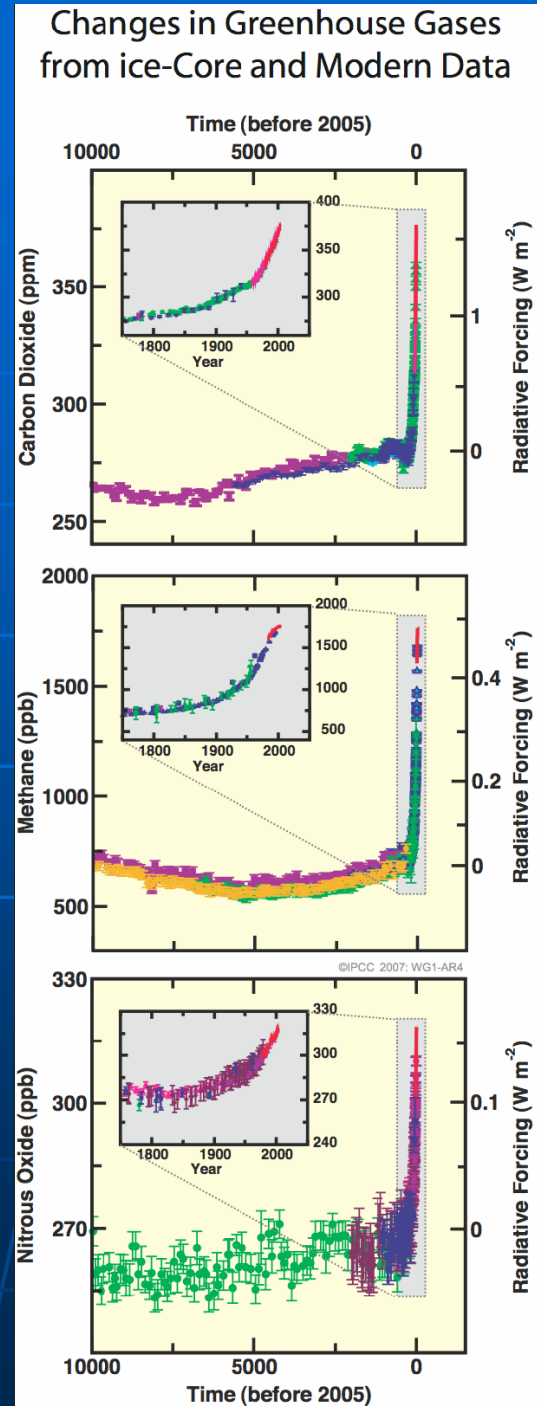
## What you can do

# The Greenhouse Effect

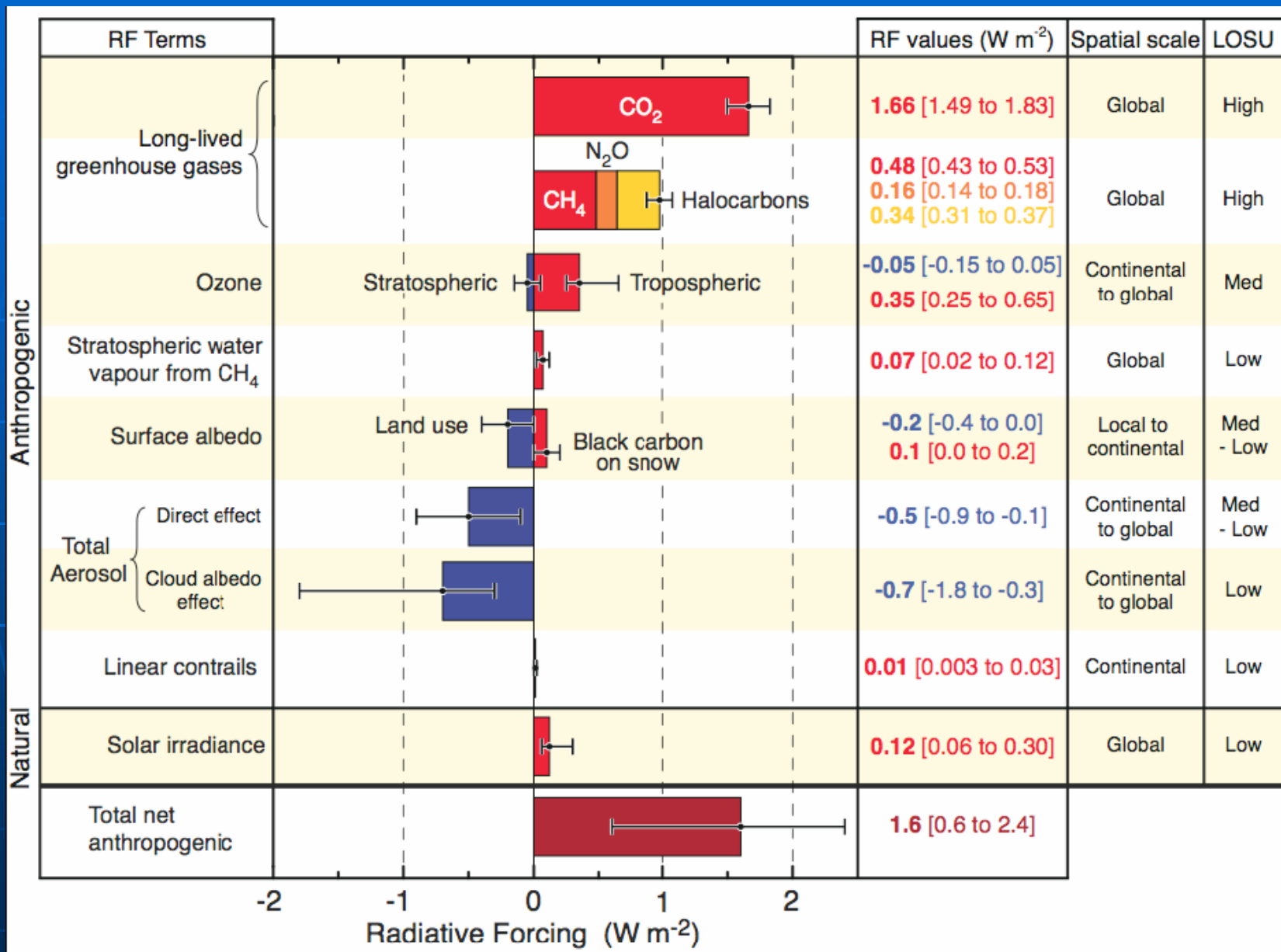


# G-H Gases: Concentrations and Radiative Forcing

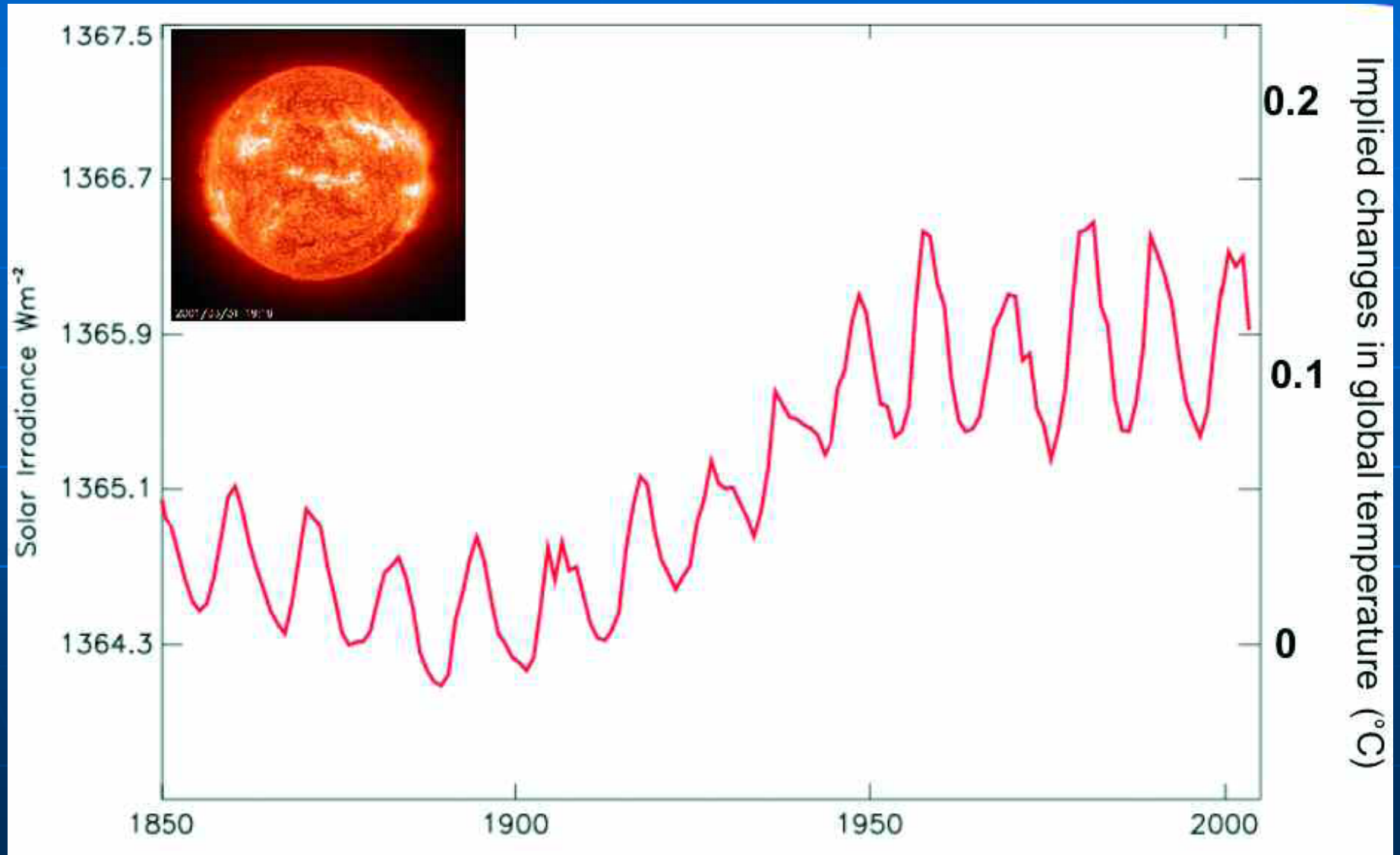
Atmospheric concentrations of carbon dioxide, methane and nitrous oxide over the last 10,000 years (large panels) and since 1750 (inset panels). Measurements are shown from ice cores (symbols with different colours for different studies) and atmospheric samples (red lines). The corresponding radiative forcings are shown on the right hand axes of the large panels.



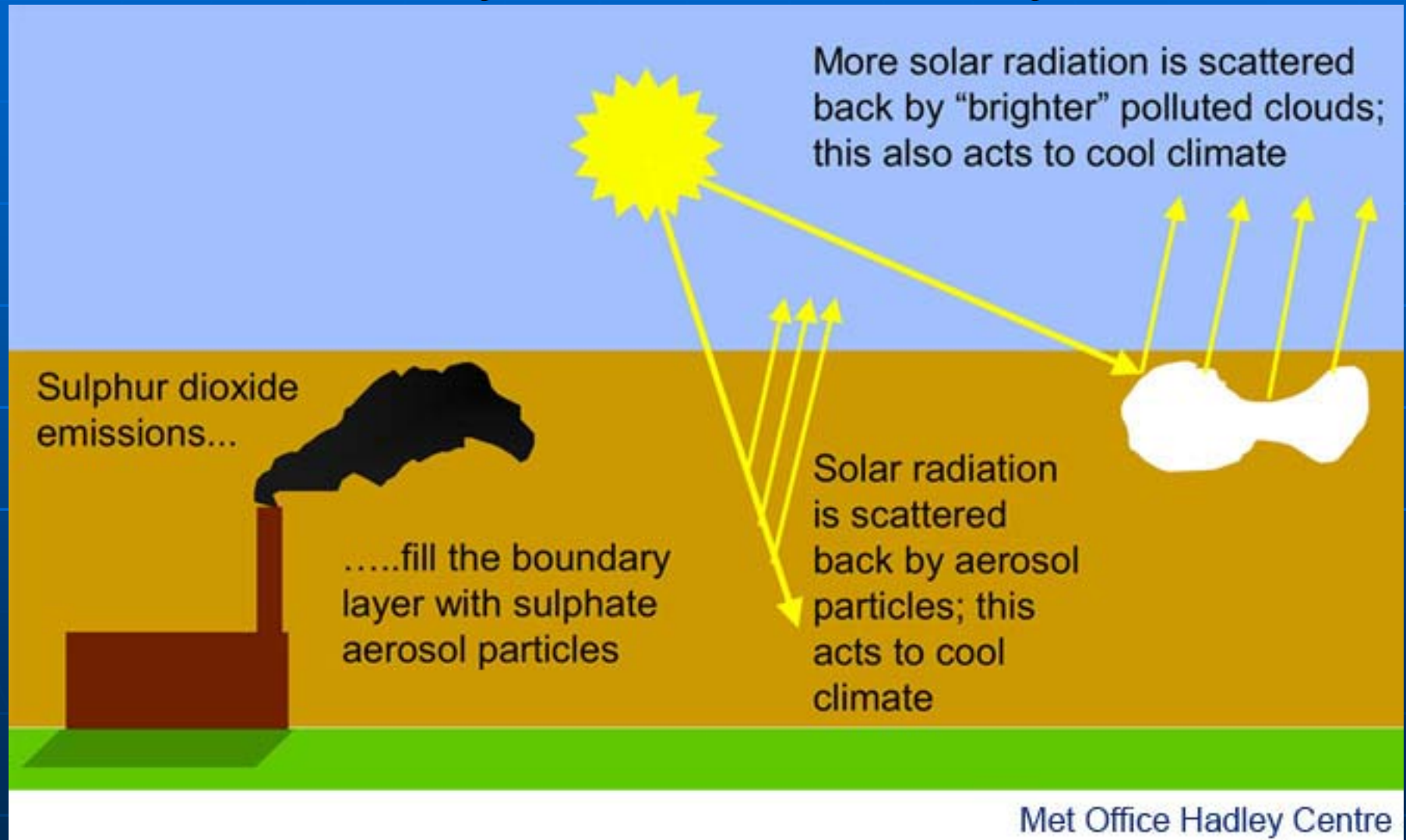
# Components of Radiative Forcing, 2005



# Changes in Solar Irradiance

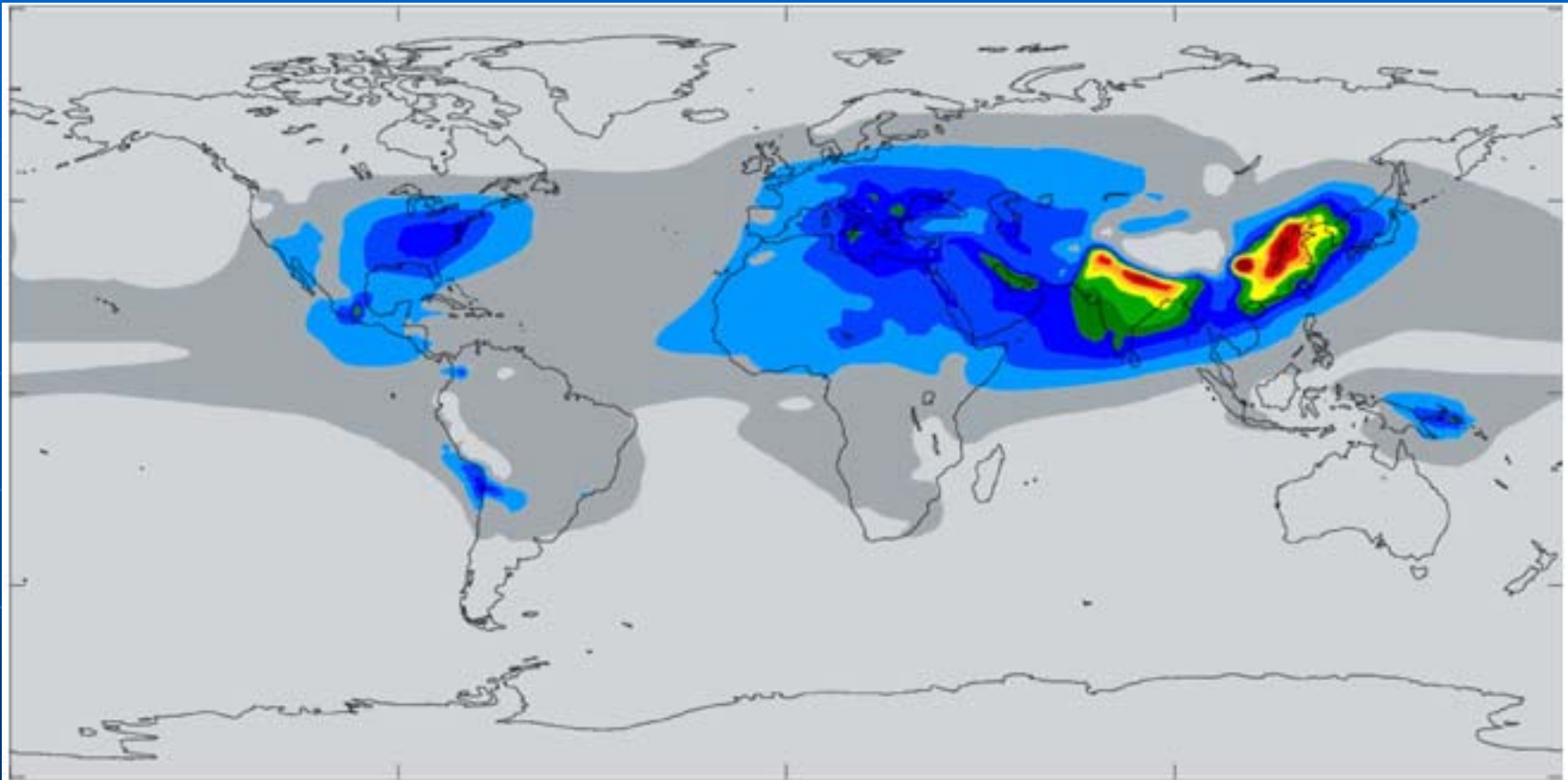


# Sulphur aerosols cool climate directly and indirectly



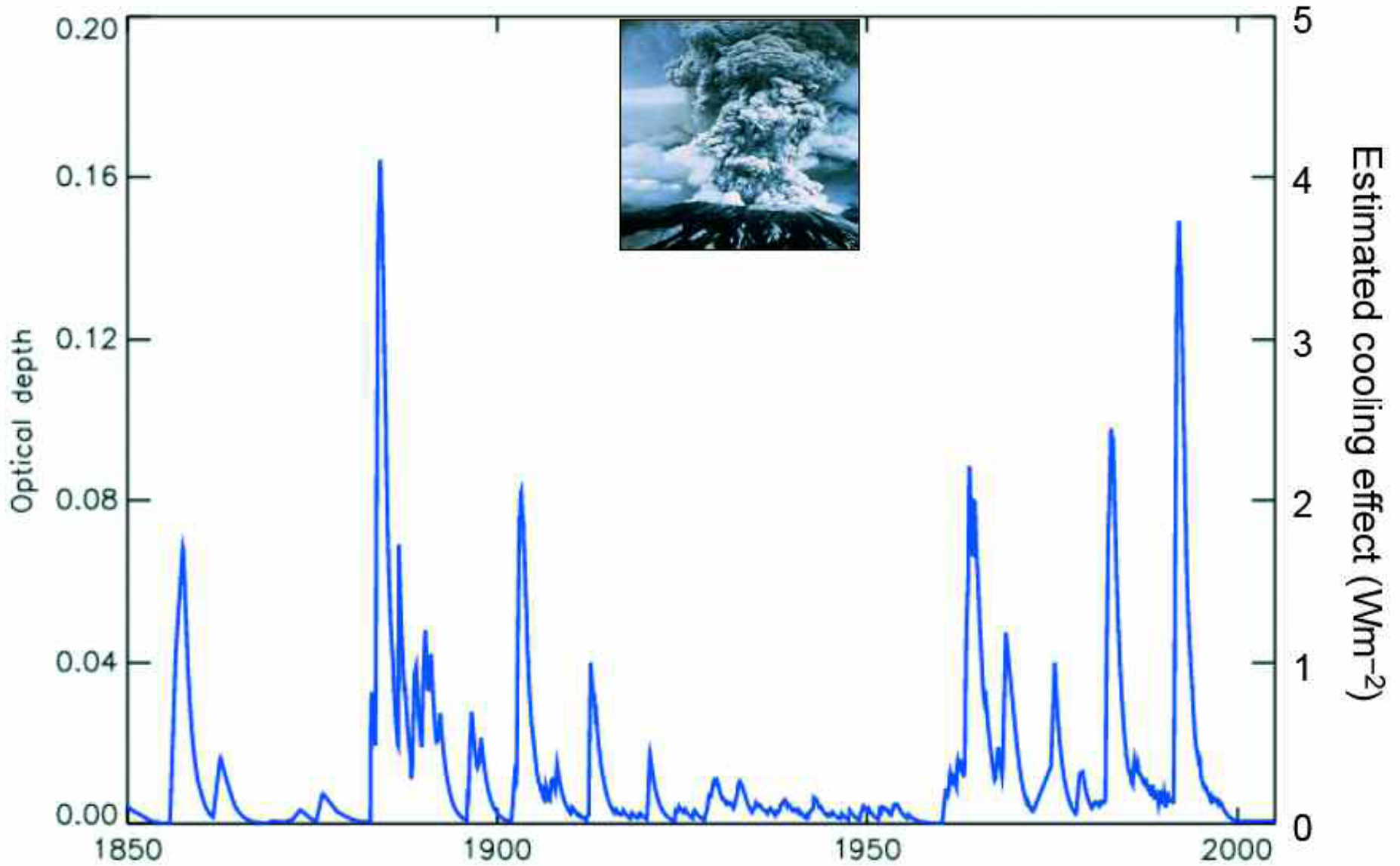
Met Office Hadley Centre

# Estimated burden of sulphate aerosol, in 1990s



Met Office Hadley Centre

# Cooling Effect of Volcanic Aerosols





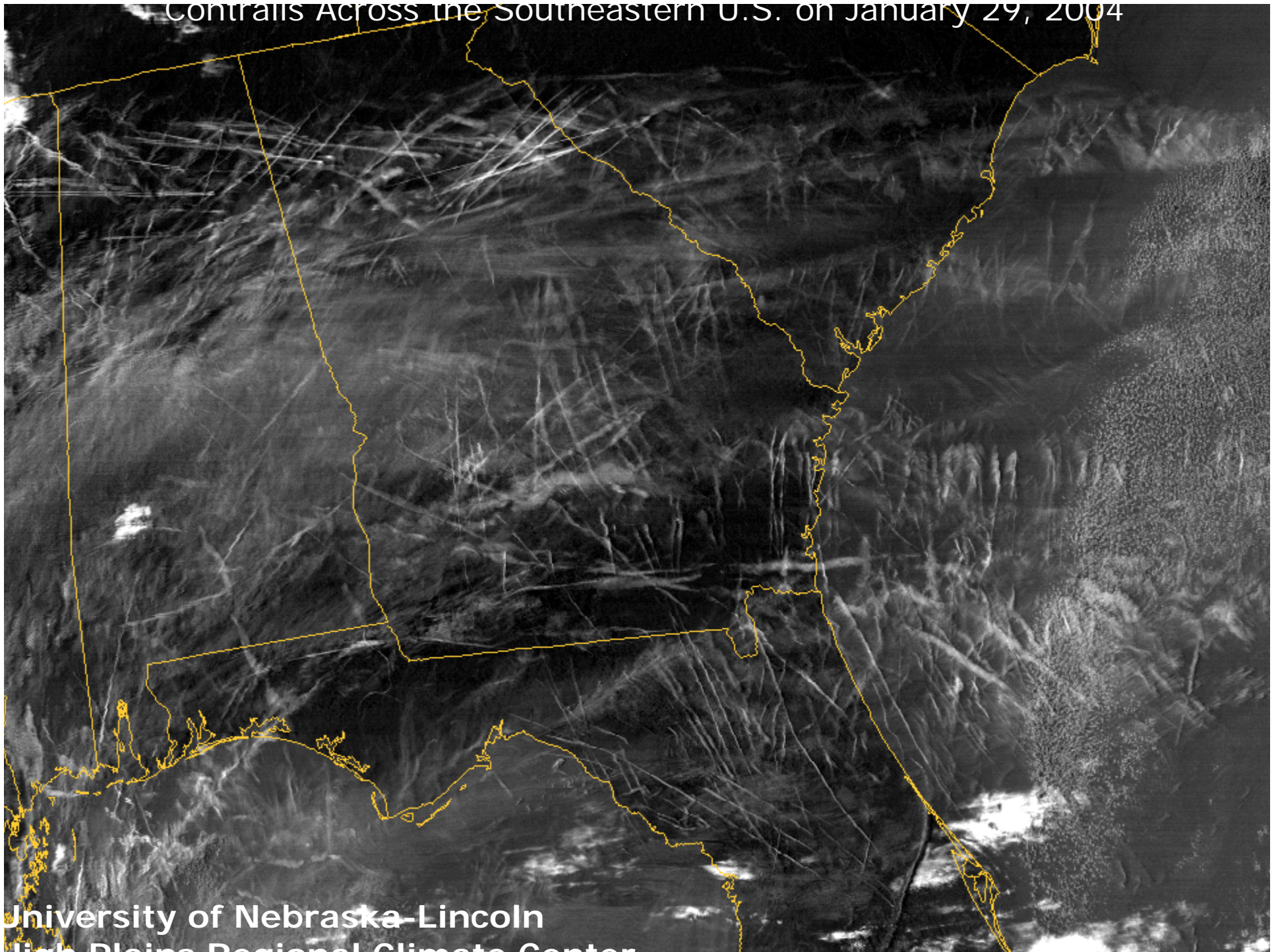
# Clouds



“As has been the case since the first IPCC Assessment Report in 1990, probably the greatest uncertainty in future projections of climate arises from clouds and their interactions with radiation.”

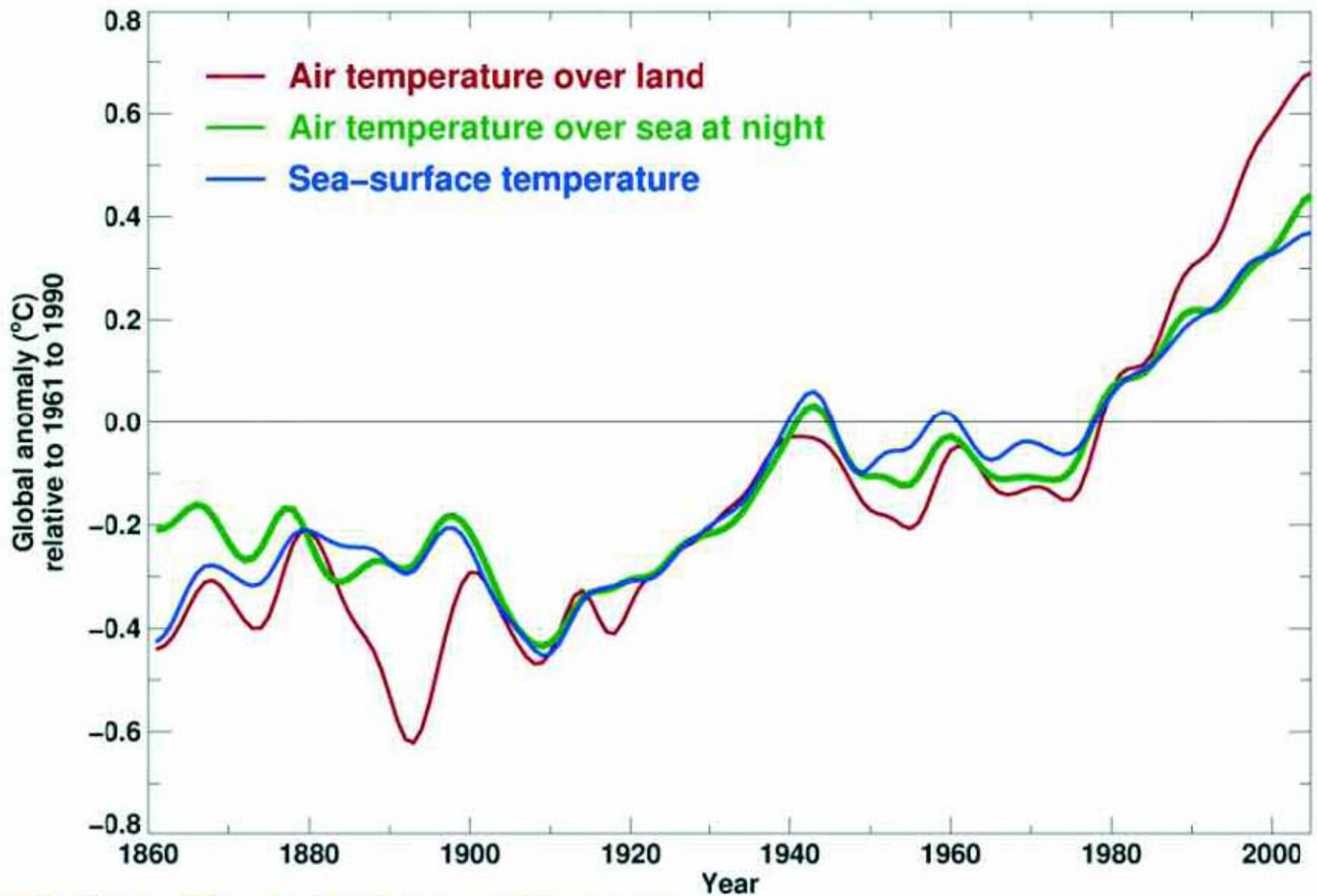
From: Intergovernmental Panel on Climate Change (IPCC), Climate Change 2001: Technical Summary of the Working Group I Report, Cambridge University Press (2001)

Contrails Across the Southeastern U.S. on January 29, 2004

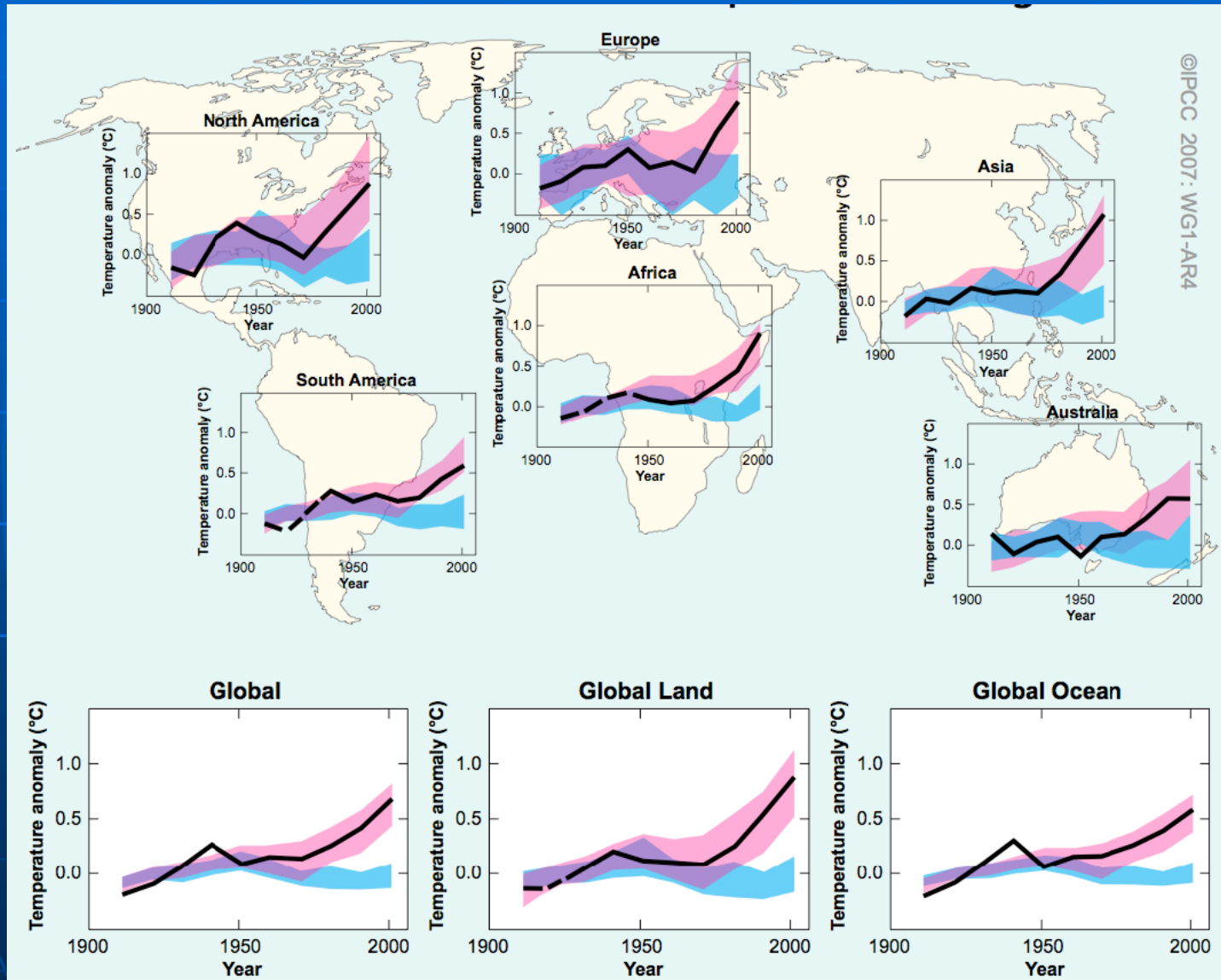


University of Nebraska-Lincoln  
High Plains Regional Climate Center

# Observed Global Warming

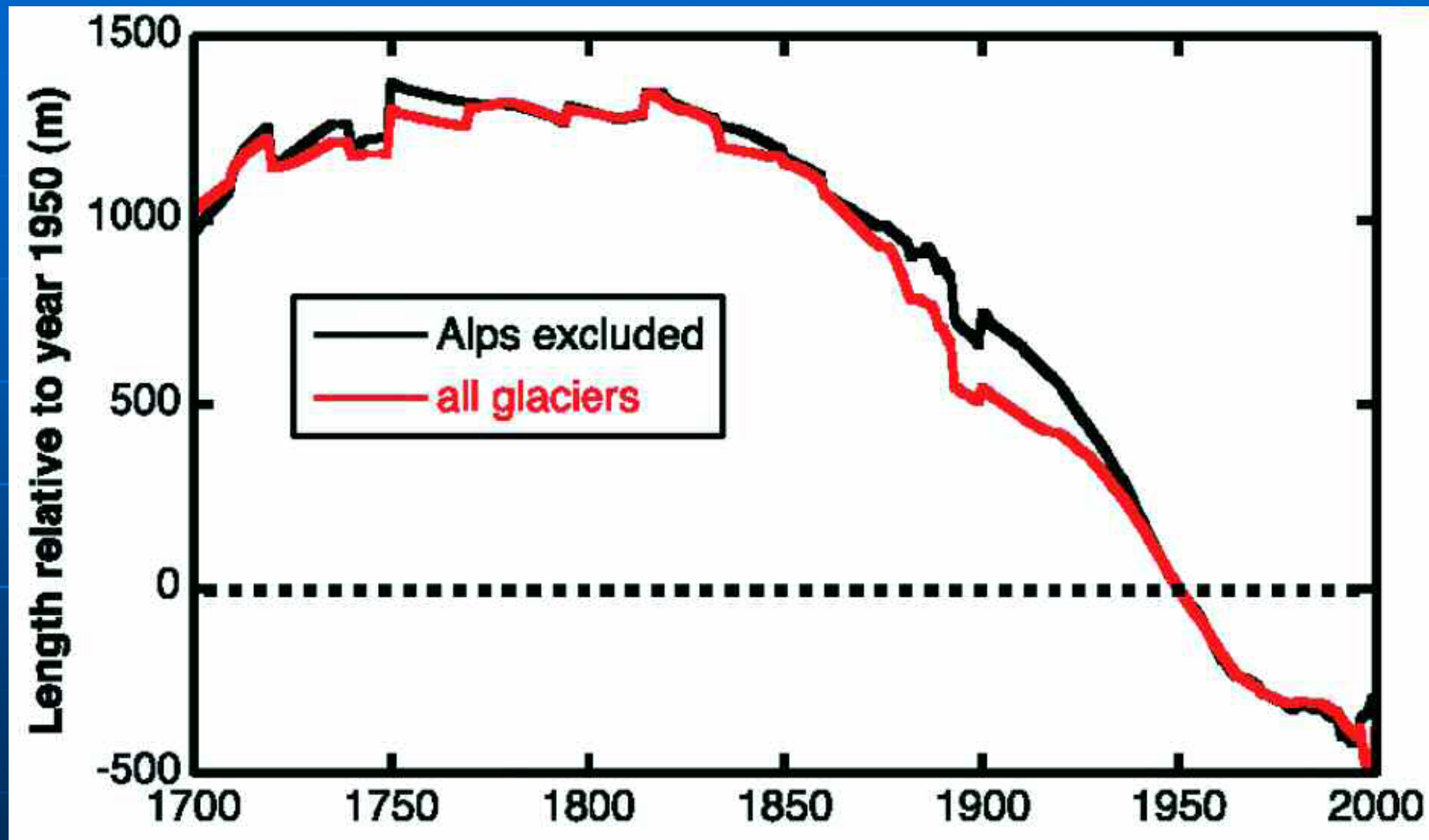


# Continental Changes in Temperature

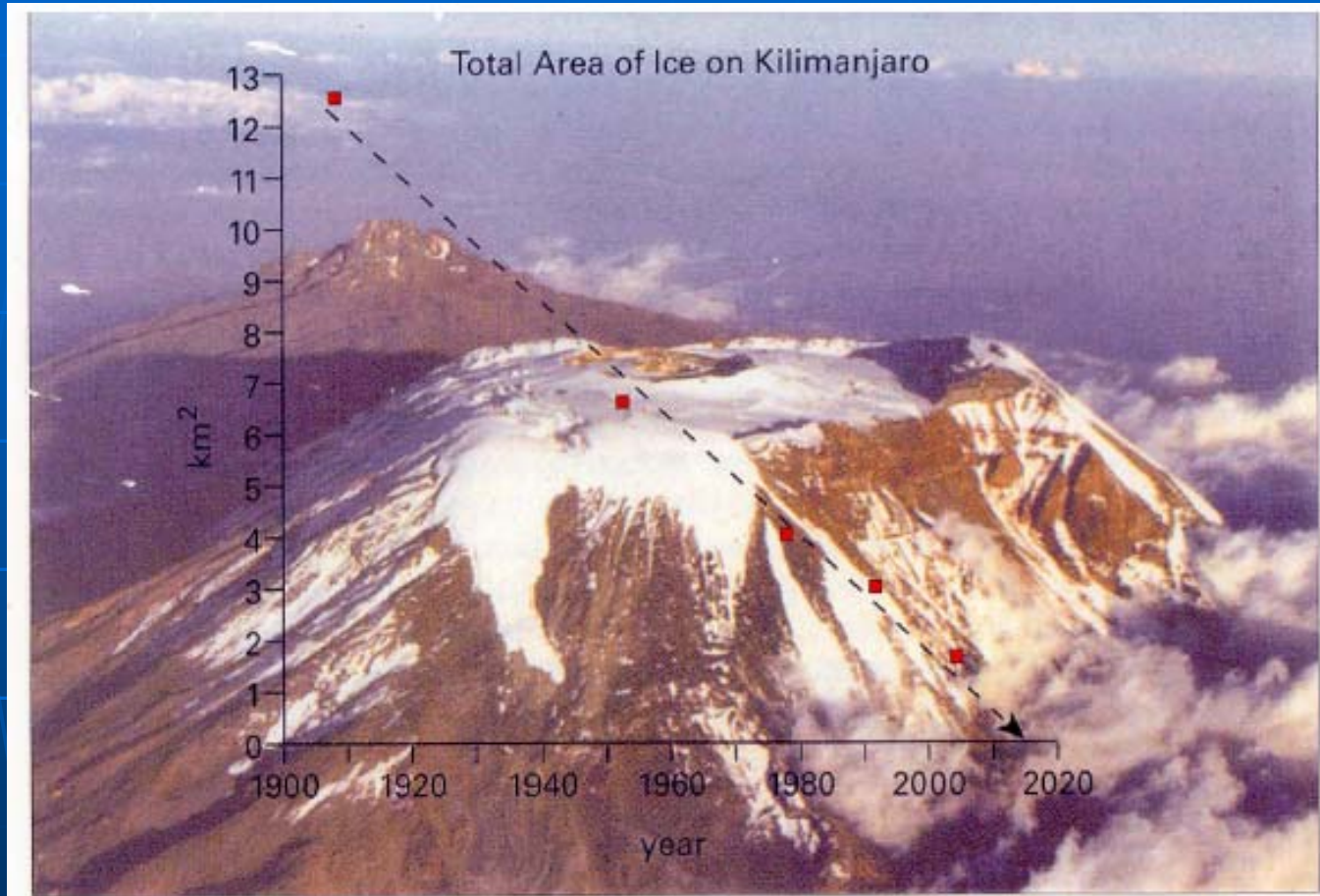


Intergovernmental Panel on Climate Change (IPCC), WGI Fourth Assessment Report 2007: Summary for Policymakers, Cambridge University press, 2007). <http://www.ipcc.ch>

# Retreat of glaciers



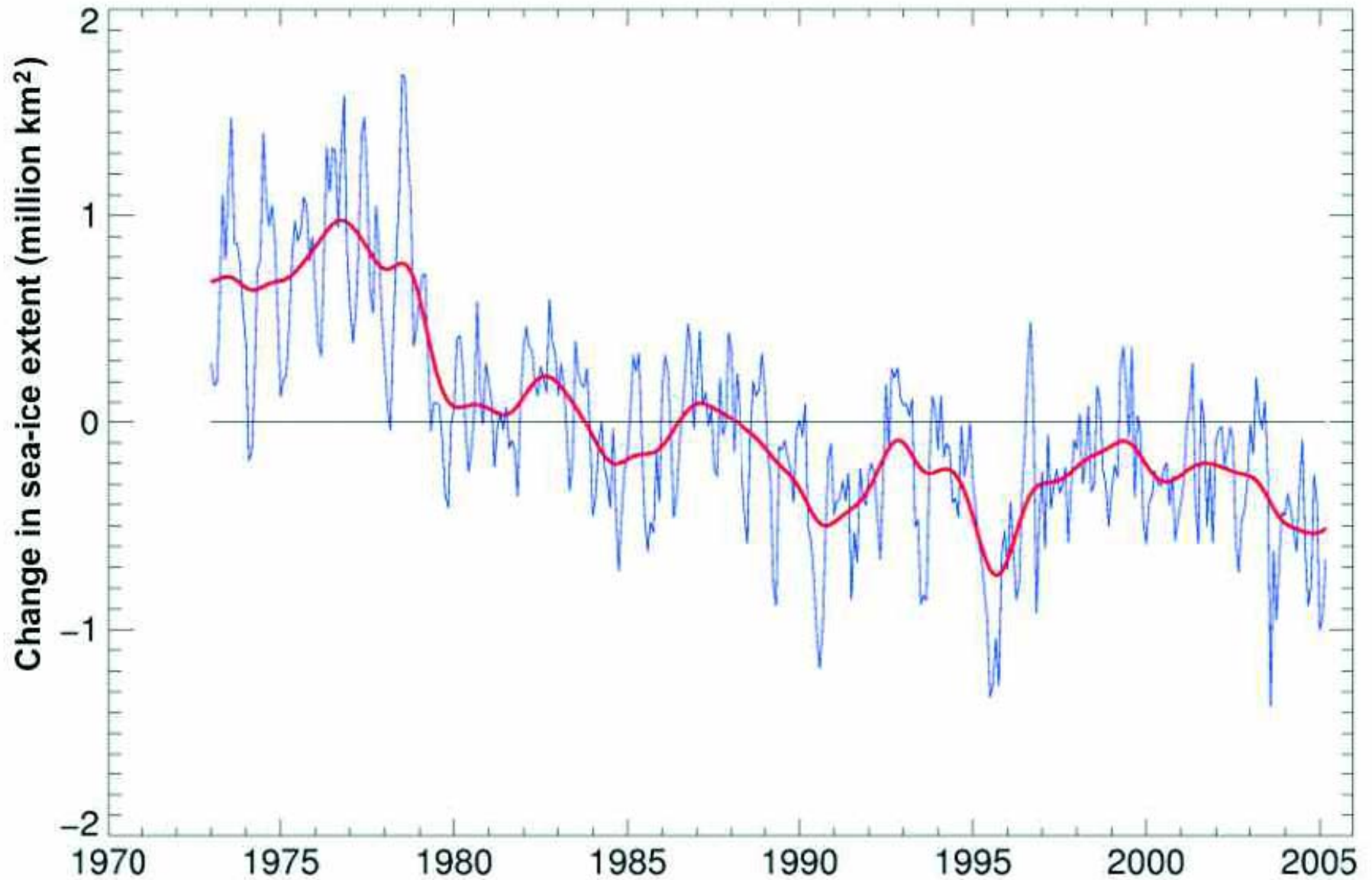
# Evidence for global warming?



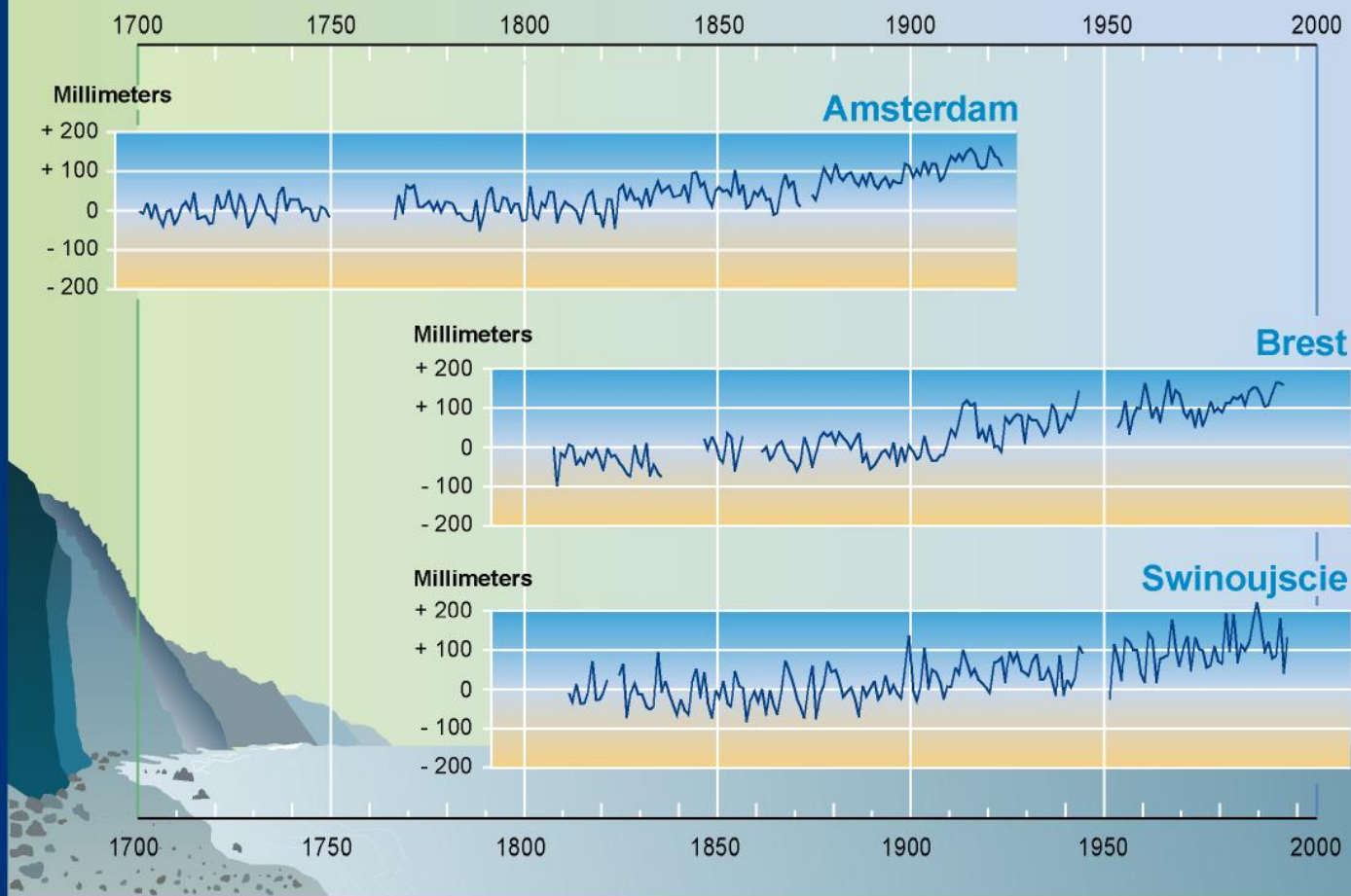
The extent of the ice cover on Mt. Kilimanjaro decreased by 81% between 1912 and 2000.

Schneider, Stephen, *Overview of "Dangerous" Climate Change*, Scientific Symposium on Stabilization of Greenhouse Gases, U.K. Met. Office, Feb. 2005.

# Decrease in Arctic Sea-Ice



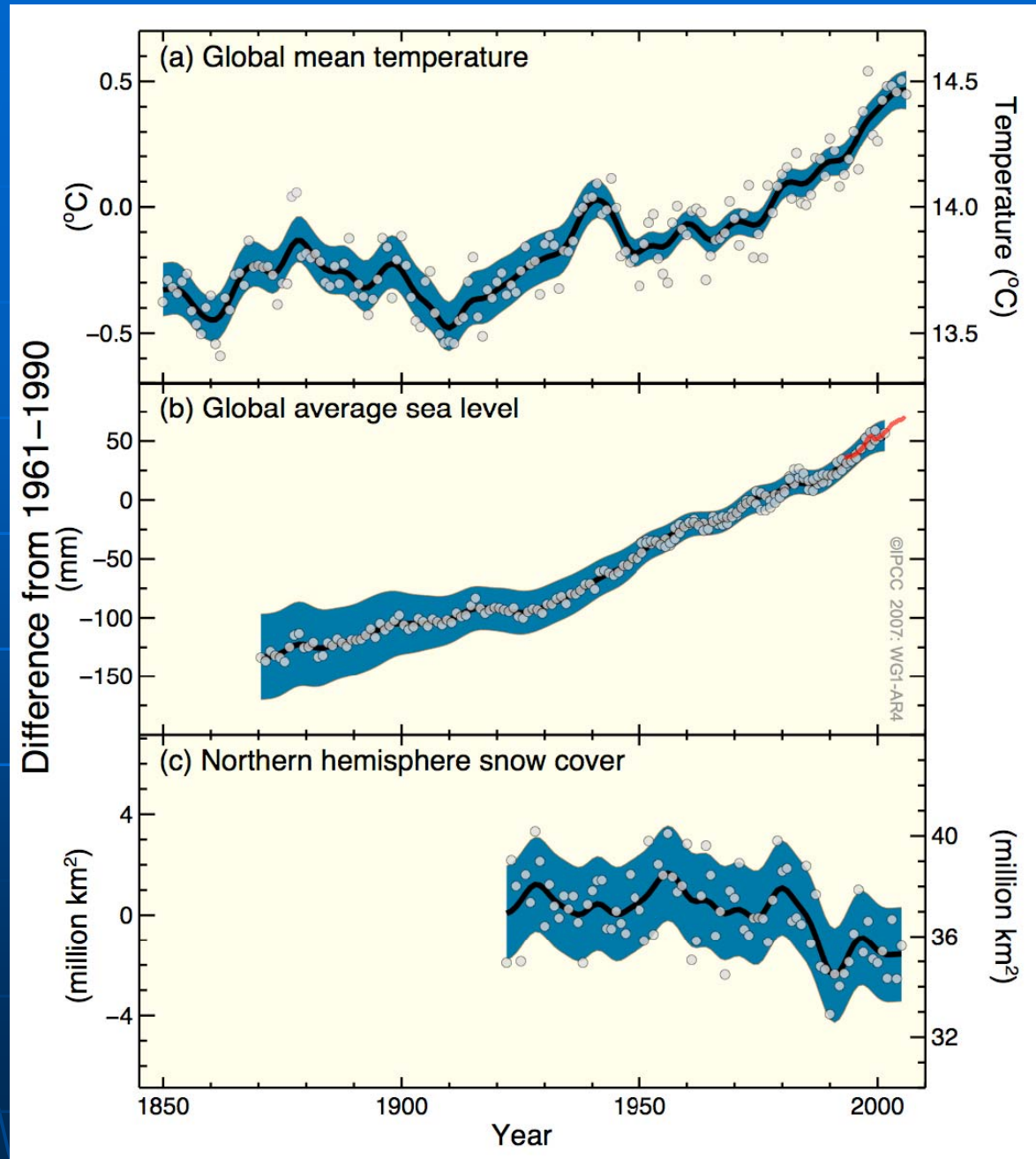
# Relative sea level over the last 300 years



SYR - FIGURE 2-5

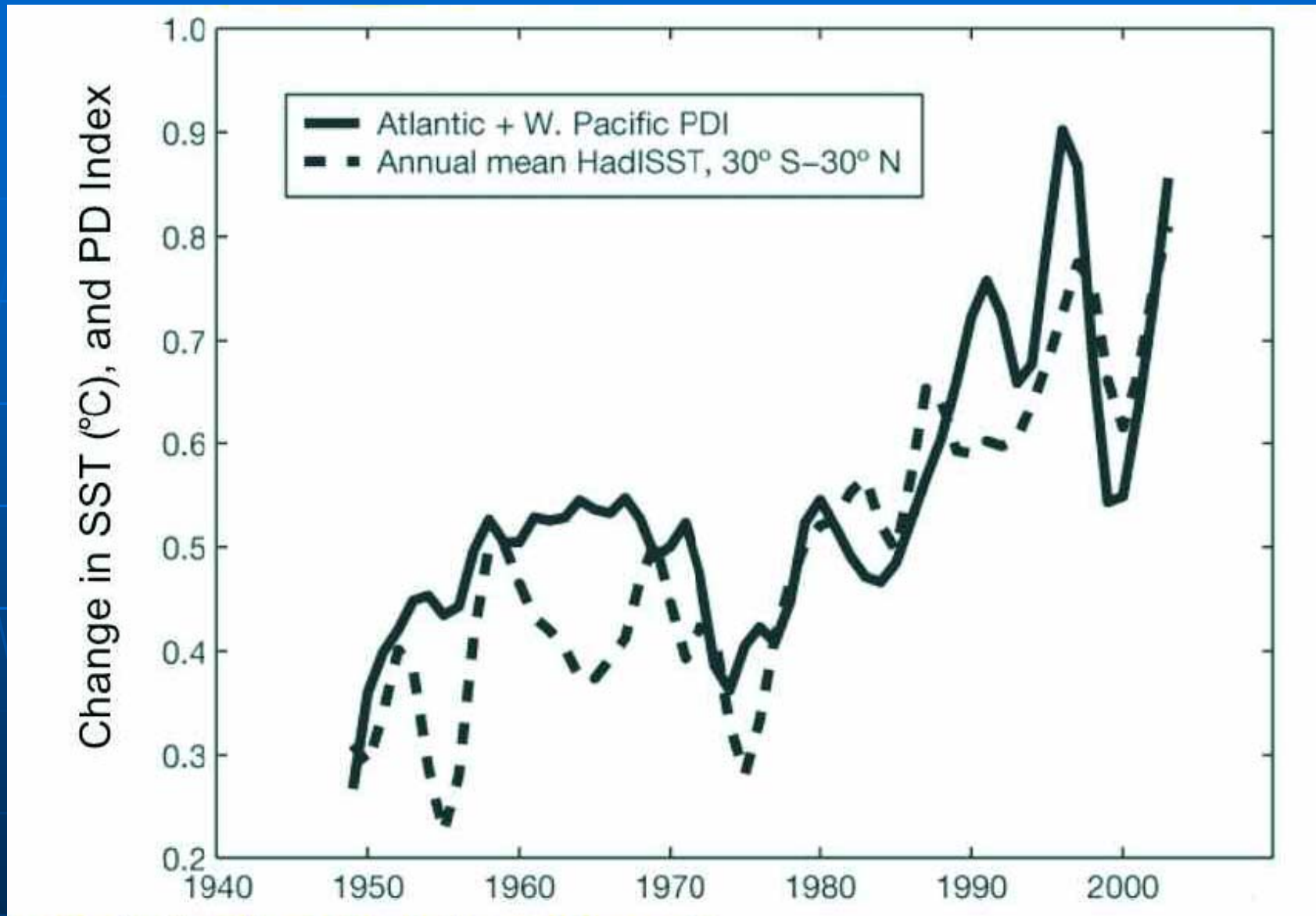


# Observed Changes in Sea Level, Temperature and N.H. Snow Cover

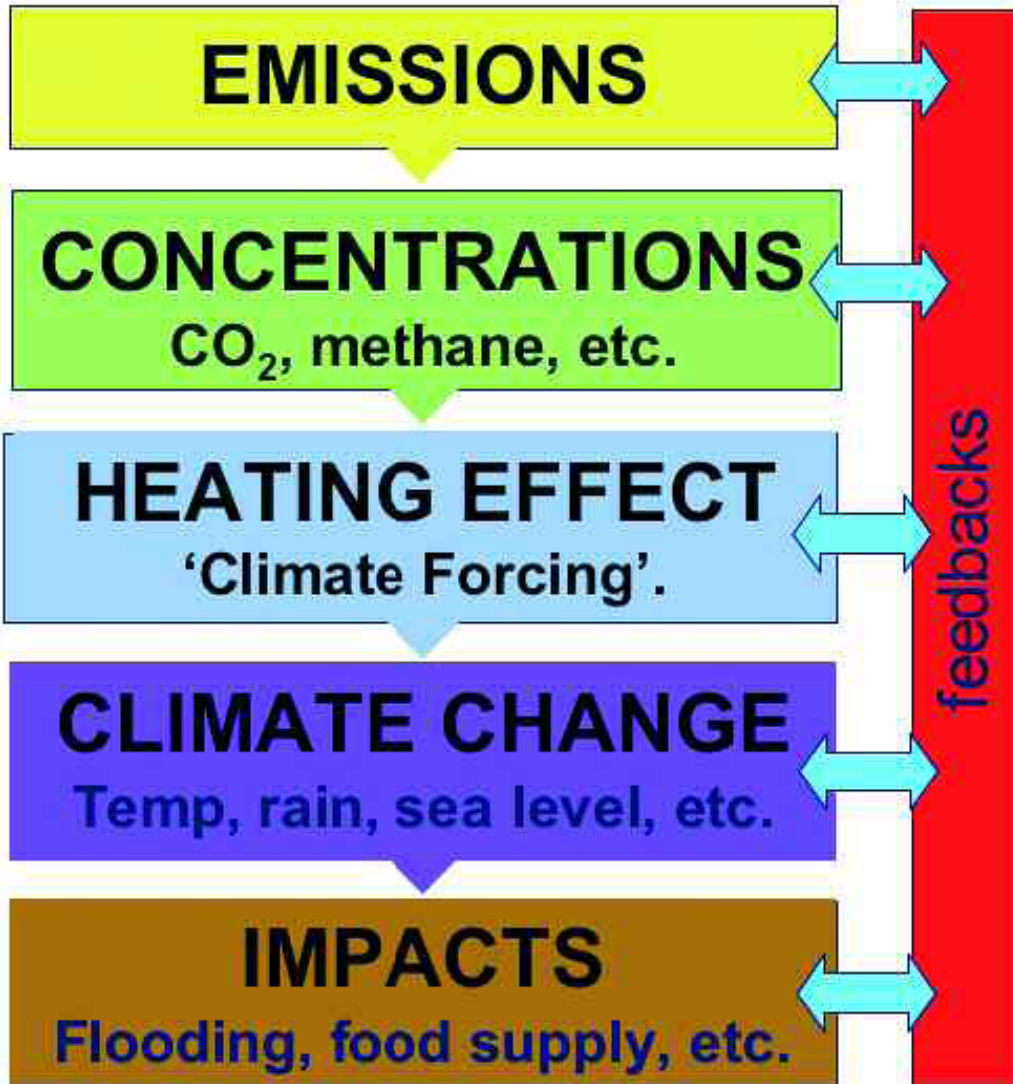


Intergovernmental Panel on Climate Change (IPCC), WGI Fourth Assessment Report 2007: Summary for Policymakers, Cambridge University press, 2007). <http://www.ipcc.ch>

# Tropical Storm Indicators



SST = Sea Surface Temperature.  
PDI = (Hurricane) Power Dissipation Index



Scenarios from population, energy, economics models

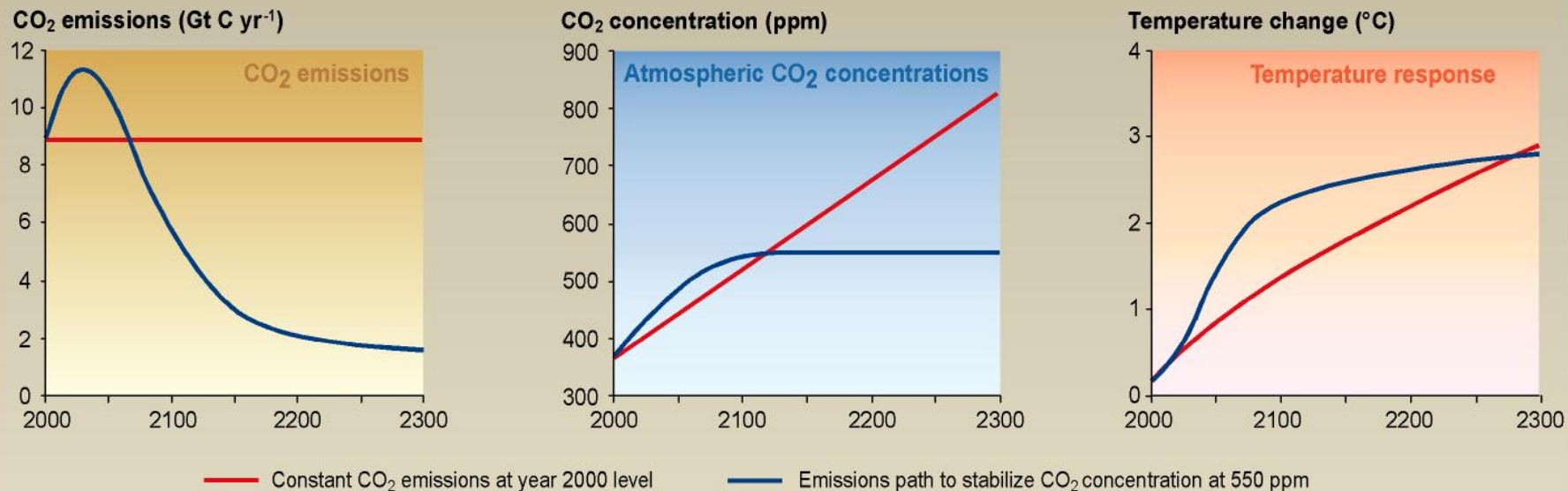
Carbon cycle and chemistry models

Gas properties

Coupled climate models

Impacts models

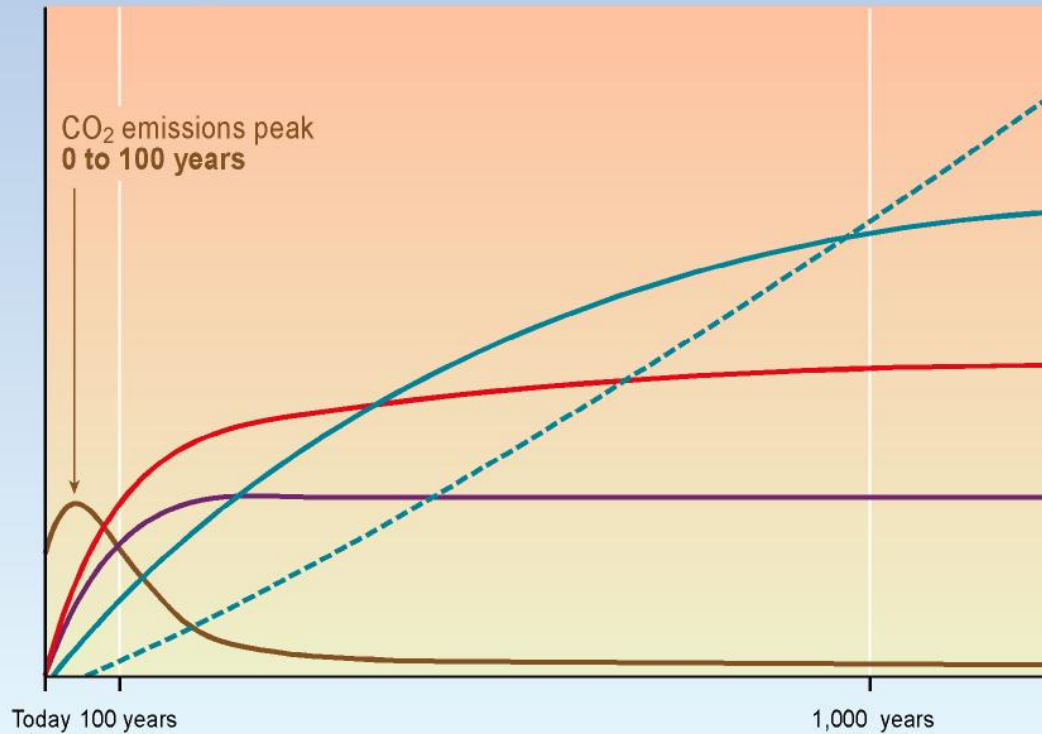
## Impact of stabilizing emissions versus stabilizing concentrations of CO<sub>2</sub>



SYR - FIGURE 5-2

## CO<sub>2</sub> concentration, temperature, and sea level continue to rise long after emissions are reduced

Magnitude of response



Time taken to reach equilibrium

Sea-level rise due to ice melting:  
**several millennia**

Sea-level rise due to thermal expansion:  
**centuries to millennia**

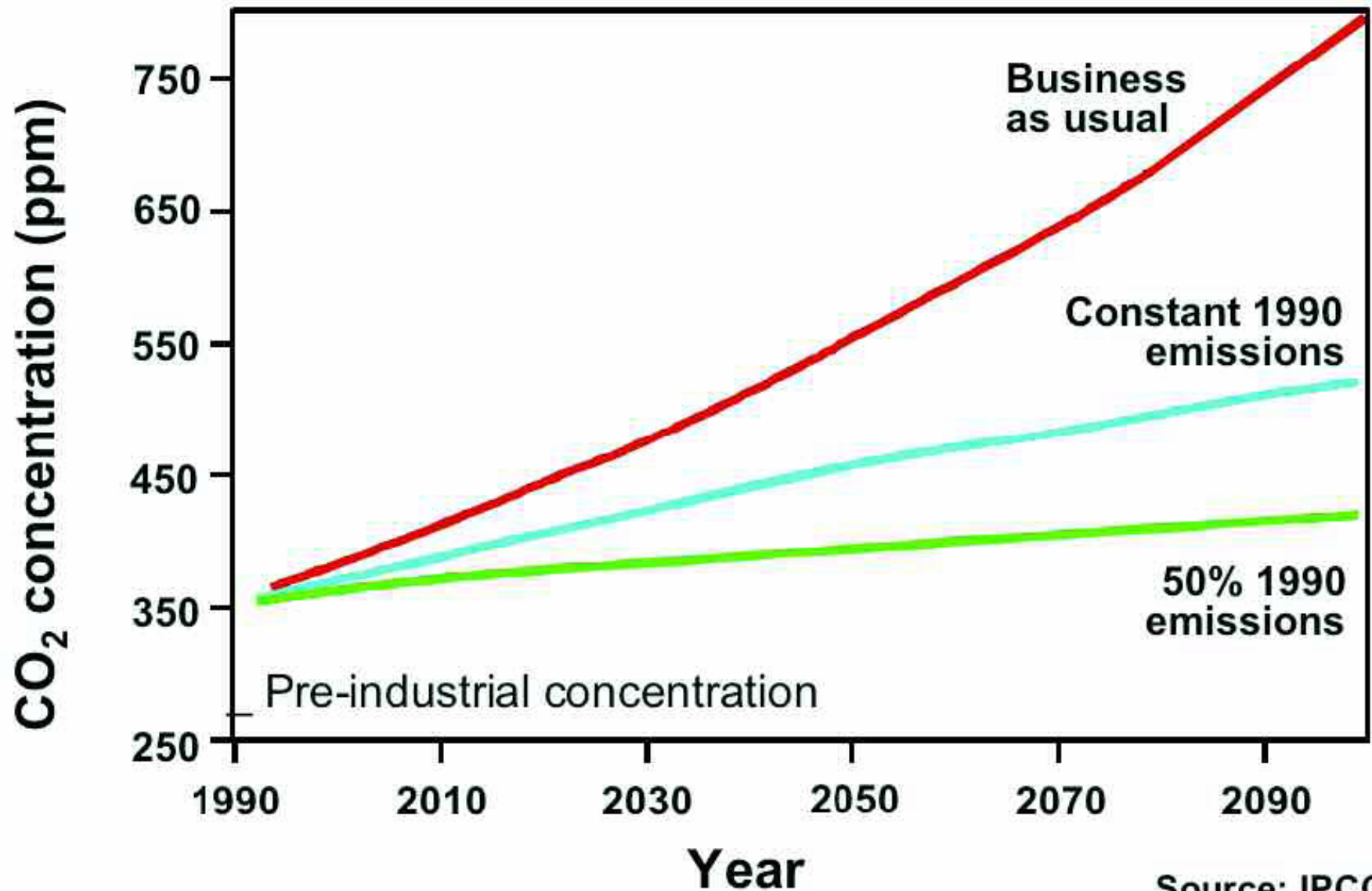
Temperature stabilization:  
**a few centuries**

CO<sub>2</sub> stabilization:  
**100 to 300 years**

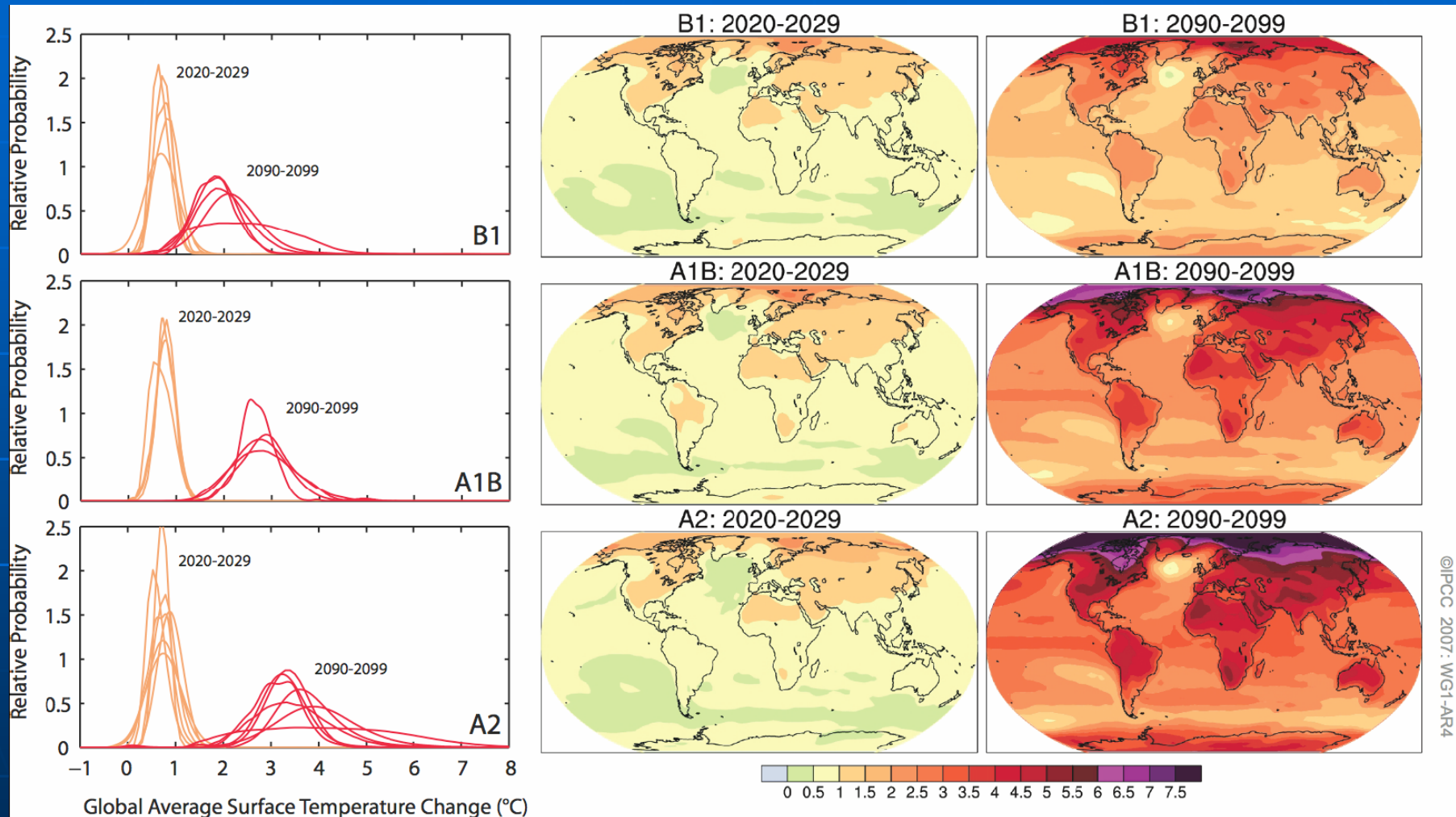
CO<sub>2</sub> emissions

SYR - FIGURE 5-2

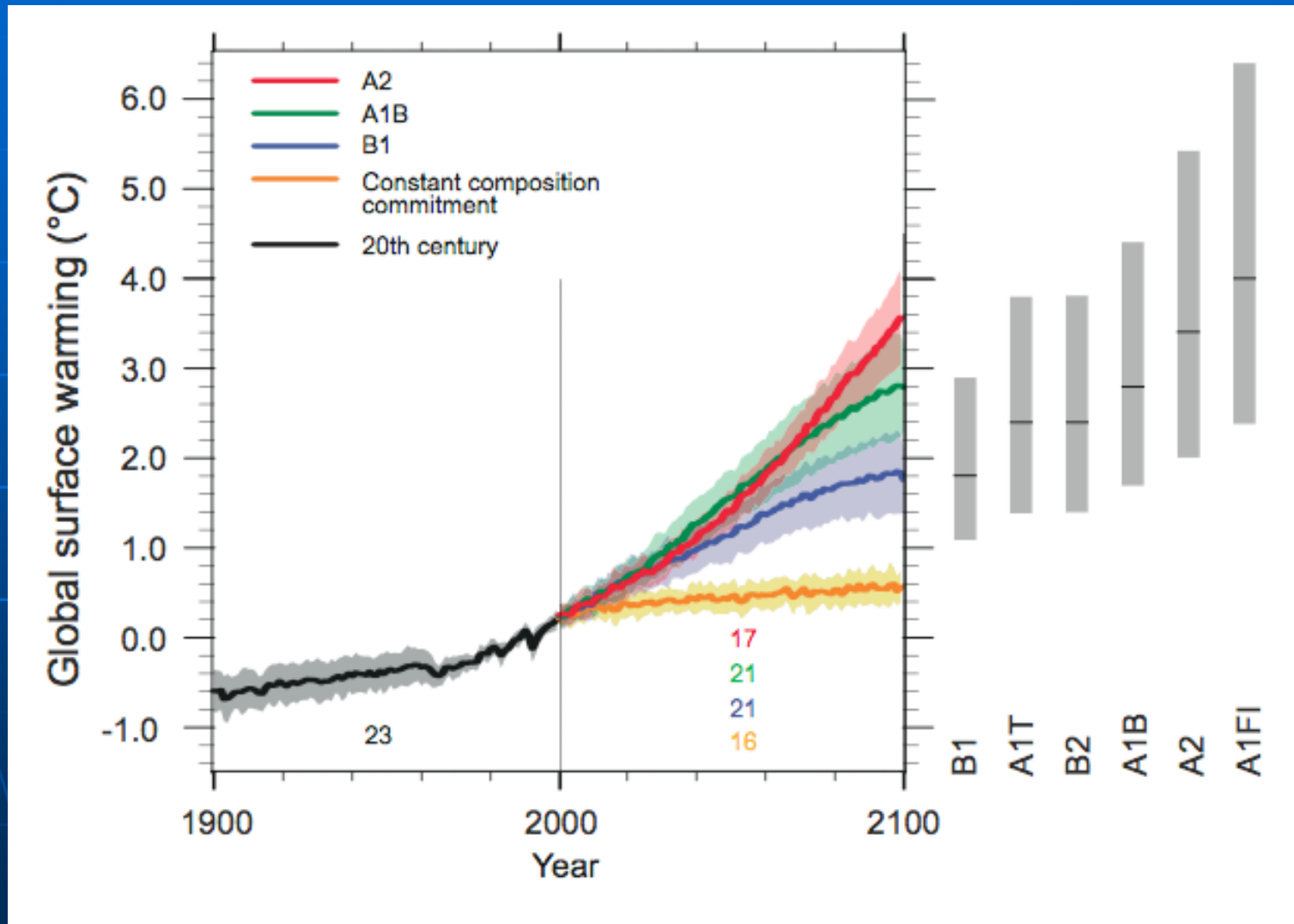
# Required reductions in CO<sub>2</sub> concentrations



# Projected Changes in Temperature



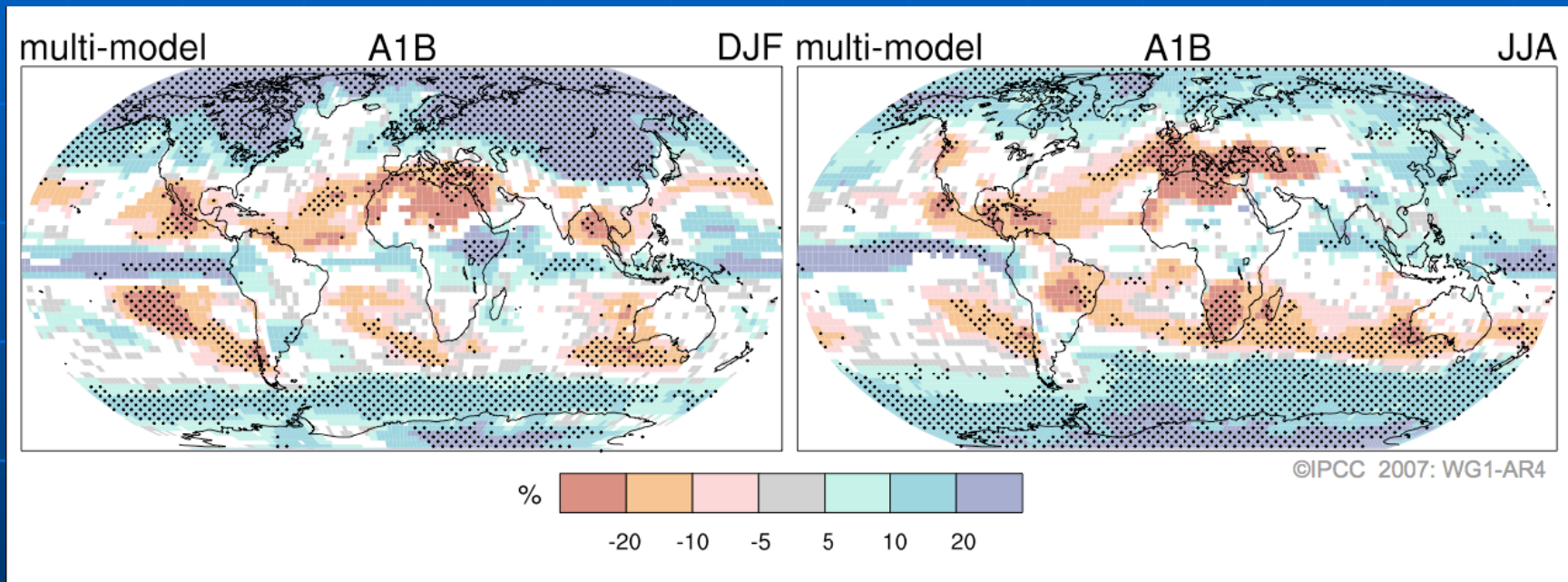
# Global Averages of Surface Warming (relative to 1980-99)



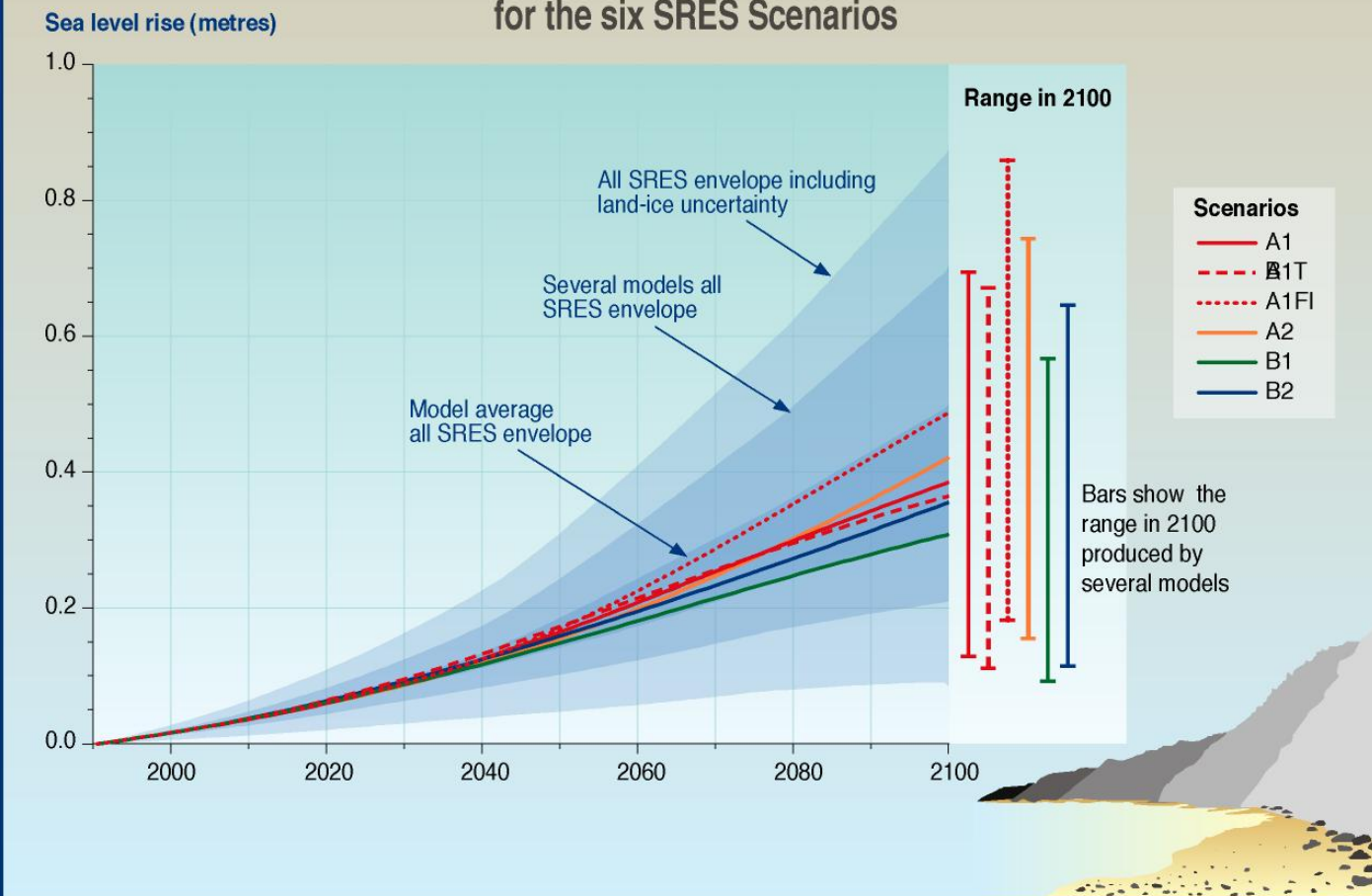


# Projected Changes in Precipitation

(for 2090-2099 relative to 1980-1999)

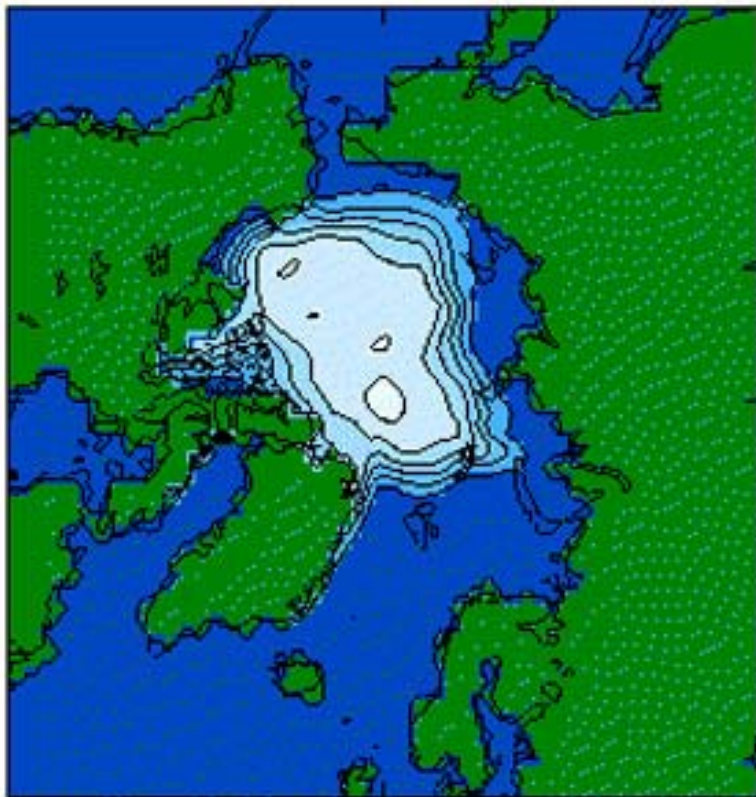


# Global average sea level rise (1990 - 2100) for the six SRES Scenarios



WG1 TS FIGURE 24

# Arctic summer sea-ice could disappear by 2080s under IPCC High Emissions scenario



Present day



0 0.15 0.3 0.45 0.6 0.75 0.9  
Fractional ice concentration



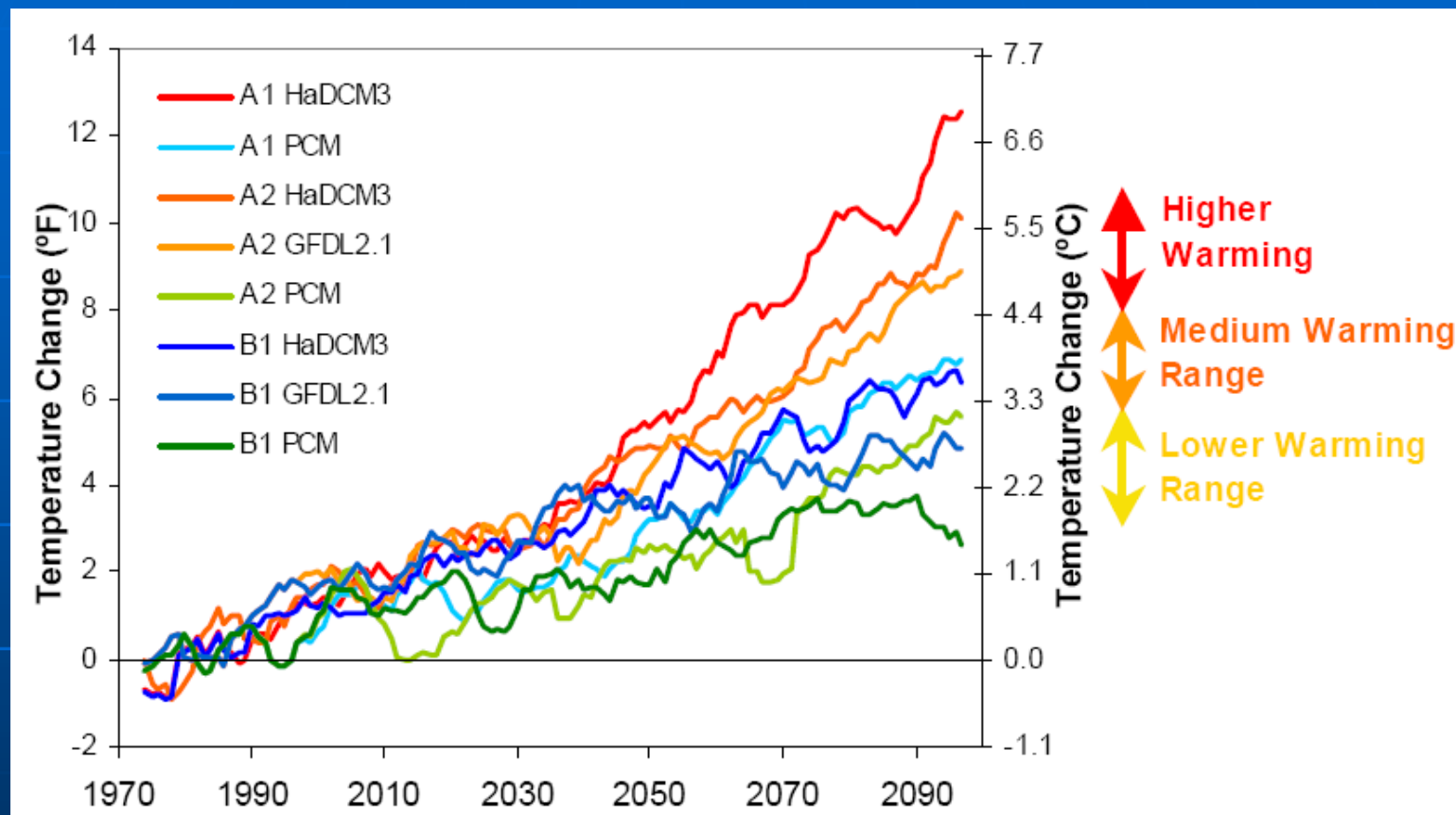
2080s



0 0.15 0.3 0.45 0.6 0.75 0.9  
Fractional ice concentration

Met Office Hadley Centre

# Predicted Climate Changes in California: Temperature



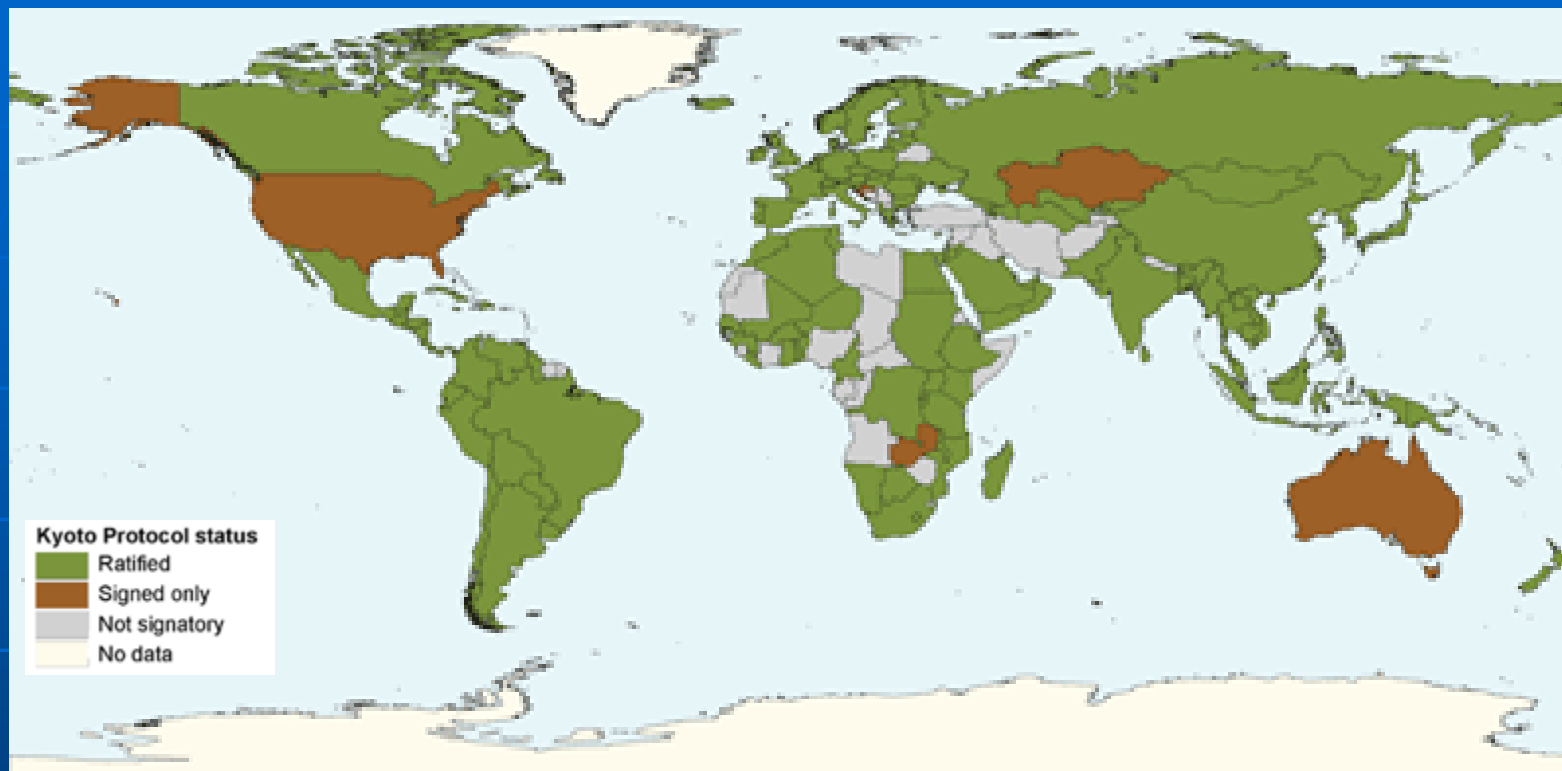
Low range: 3.0°F – 5.4°F

Medium range: 5.5°F – 7.8°F

High range: 8.0°F – 10.4°F

Greater warming in summer than winter

# Mitigation Efforts: Kyoto Protocol



The Kyoto Protocol, an international agreement to reduce emissions of six greenhouse gases, came into effect on February 16, 2005. The protocol sets mandatory limits on greenhouse gas emissions for each of the party nations with the goal of reducing total global emissions to 5.2% below their 1990 values by 2012. 166 countries have now ratified the agreement – but not the U.S.

# Mitigation Efforts: California AB32

California is the 12<sup>th</sup> largest emitter of carbon dioxide in the world

On June 1<sup>st</sup>, 2005 Governor Schwarzenegger signed Executive Order S-3-05, establishing Greenhouse gas targets for the State.

On September 27, 2006 Governor Schwarzenegger signed Assembly Bill 32, California Global Warming Solutions Act of 2006, authored by Assembly Speaker Fabian Nunez (D-Los Angeles).

# Mitigation Efforts: California

- AB 32 requires that the statewide greenhouse gas emissions be cut to their 1990 levels by 2020. This will require a cut in emissions from the State's largest emitters by about 25%.
- Beginning in 2008 the California Air Resources Board will require industry to report on their G-H gas emissions.
- Reductions will be continued to 80% below 1990 levels by 2050.
- In July, 2006 an agreement was signed between California and the United Kingdom to create an international partnership to fight against global warming.
- On Jan 18, 2007, a new Low Carbon Fuel Standard was introduced for transportation fuels. This requires fuel providers to reduce the carbon content of passenger vehicle fuels sold in California by 10% by the year 2020. Transportation accounts for 40% of California's GHG emissions, and 96% of these fuels are petroleum based.

# What you can do: Bills to support

On January 16, 2007 Senators Sanders and Boxer introduced bill **S. 309**, the **Global Warming Pollution Reduction Act**, to “amend the Clean Air Act to reduce emissions of carbon dioxide and other purposes”. This act calls for a reduction in emissions in order to prevent global temperature from increasing an additional 2 degrees Celsius above the pre-industrial average. This bill aims to contain carbon dioxide concentrations to 450 ppm, and reduce greenhouse gases by 80% below 1990 levels by 2050.

**Call your senator at (202)-224-3121 and urge him or her to cosponsor S. 309.**



# What you can do: Bills to support

Introduced by Senator Dianne Feinstein on January 22, 2007, bill **S. 357**, the "**Ten in Ten Fuel Economy Act**", increases fuel economy standards by 10% over 10 years to an average of 35 miles per gallon for cars and light trucks by 2019. Beginning with model year 2010, passenger cars must achieve an average of 29.5 mpg, and light trucks for 2010 must achieve an average of 23.5 mpg.

Call your senator at (202)-224-3121 and urge him or her to cosponsor S. 357.

# What you can do: Bills to support

Introduced by Rep. Tom Udall (D-CO) and Rep. Todd Platts (R-PA) on February 8, 2007, bill **HR 969**, the "**Renewable Energy Standard Bill**", requires 20% of generated energy to come from renewable sources, such as wind and solar, by 2020. Energy producers can earn, trade, borrow, and purchase credits for meeting requirements.

**Call your senator at (202)-224-3121 and urge him or her to cosponsor H.R. 969!**

# What you can do: Citywide measures

## Green Vehicles

Improving automobile fuel economy is the biggest single step to curbing global warming, since every gallon of gasoline burned creates 28 pounds of carbon dioxide pollution.

Use hybrid gas-electric and other vehicles that go farther on a gallon of gas. Currently, 48 U.S. towns and cities in 36 states have green fleets programs, as do 26 county and 17 state governments.

Encourage citizens and businesses to buy hybrid vehicles with a wide range of incentives. Some cities are already providing incentives such as free parking for hybrid vehicles and lower registration fees and taxes.

Replace old buses with buses that run on cleaner compressed natural gas (CNG) or with hybrid-electric diesel engines.

# What you can do: Citywide Measures

## Energy Efficiency

Use less energy through better technology to power buildings, light streets, and industry.

Incorporate energy efficiency requirements into municipal building codes. Many cities have chosen to adopt the Leadership in Energy and Environmental Design (LEED) standards created by the United States Green Building Council ([usgbc.org](http://usgbc.org)).

Modernize lighting, heating, cooling, and other operations to reduce the energy requirements of existing buildings in a cost-effective manner, lowering energy costs and reducing pollution.

Street lighting and traffic signals can use a significant amount of energy. Replace traditional light fixtures with light emitting diode (LED) bulbs.

Cities and businesses can also benefit from combined heat and power (CHP) systems. These systems produce both electricity and steam for heating and cooling from a single power plant located near consumers. As a result, CHP systems recover heat that is normally wasted at power plants and funnel the heat into surrounding buildings.

# What you can do: Citywide measures

## Renewable Energy

By harnessing natural sources of energy like the sun and the wind, renewable energy sources can replace our reliance on outdated, polluting power plants that rely on fossil fuels.

Set a renewable energy standard requiring an increase in the percentage of electricity from clean, renewable energy sources (such as wind and solar power) in a city or utility area by a specific target date. These standards are phased in over time so that renewable energy capacity can be built and incorporated into the necessary energy management and reliability plans.

Finance the construction of renewable energy projects themselves. In some cases, cities are working with local municipal utilities to construct wind turbines. In other cases, cities are working with privately owned utilities and renewable energy developers to construct solar arrays on city buildings, schools, and homes.

Incorporate renewable energy requirements into contract renewals with privately owned local utilities.

# What you can do

## Support and encourage local alternative energy projects.



In 2005 CSUN installed a 1 megawatt fuel cell power plant — the single largest fuel cell power plant at any university in the world. The power plant provides environmentally friendly power to the campus, and reduces the university's CO2 emissions by 60 million pounds during its lifetime. The plant will generate electricity for the university's facilities and surplus heat for buildings, showers and food service hot water, and for heating the swimming pool.

In 2001, CSUN installed six microturbines through a partnership with the South Coast Air Quality District and LADWP as a way to save energy and reduce its reliance on the state's fragile electrical grid.

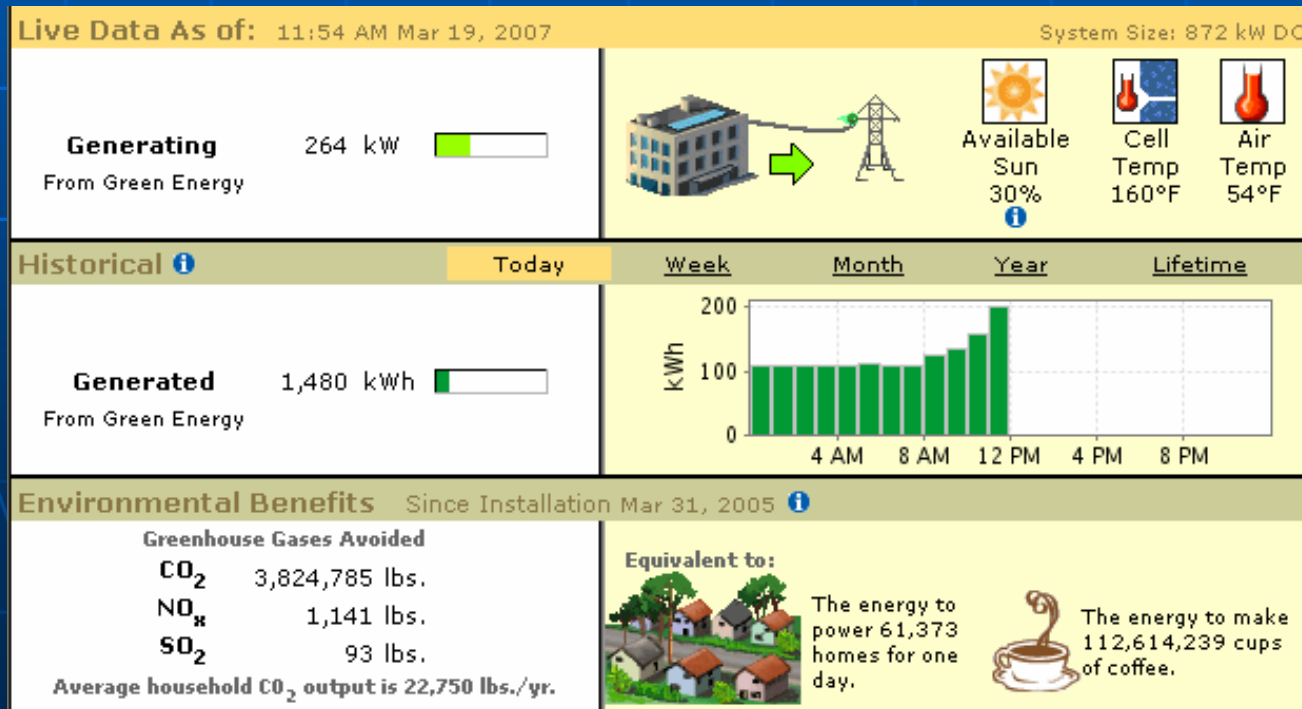


# What you can do

Support and encourage local alternative energy projects.



CSUN, with support of LADWP and the Gas Company has installed nearly 6,000 solar panels totaling nearly 700,000 watts of power on the campus as a way of providing power while saving energy and reducing costs.



# What you can do: Personal options



**Plant trees**

**Install solar panels**

**Switch to energy saving appliances**

**Recycle**

**Drive a fuel efficient vehicle**

**Use mass transit, cycle, carpool**

**Buy green energy**





# What you can do: Personal options

**Turn off the air conditioner**

**Turn off the lights when you leave a room**

**Install compact fluorescent light bulbs**

**Don't fly unless you have to**

**Buy locally grown produce**

**Put your water heater on a timer**

**Use recycled paper and timber**

# What you can do: Websites

**If you visit only one site, visit this one from the Union of Concerned Scientists:**

<http://www.ucsusa.org/>

**Facts and figures from the EPA:**

<http://www.epa.gov/climatechange/>

**What you can do (Inconvenient Truth):**

<http://www.climatecrisis.net/>

**The scientific facts from the IPCC (Intergovernmental Panel on Climate Change):**

<http://www.ipcc.ch/>



## 10 SIMPLE THINGS YOU CAN DO - to help stop global warming.

- 1. Replace regular lightbulbs with compact fluorescent ones.** 150 pounds of carbon dioxide (CO<sup>2</sup>) saved a year.
- 2. Drive less.** 1 pound of CO<sup>2</sup> for every mile you don't drive!
- 3. Recycle more.** 2400 pounds of CO<sup>2</sup> saved every year if half your household waste is recycled.
- 4. Keep your tyres properly inflated.** Improves gas mileage by more than 3%. Every gallon saved means 20 pounds of CO<sup>2</sup> kept out of the atmosphere!
- 5. Use less hot water.** Install a low flow showerhead (350 pounds of CO<sup>2</sup> saved per year); wash clothes in cold or warm water (500 pounds saved per year).
- 6. Avoid products with a lot of packaging.** 1,200 pounds of CO<sup>2</sup> saved per year if you reduce rubbish by 10%.
- 7. Reduce your heating and air-conditioning usage.** Save 2000 pounds of CO<sup>2</sup> a year by turning heating down by 2° in winter and air-conditioning by 2° in summer.
- 8. Plant a tree.** Just one tree absorbs a ton of CO<sup>2</sup> in its lifetime.
- 9. Turn off electronic devices instead of setting to standby.** Turning off TVs, DVDs, Stereos and computers saves thousands of pounds of CO<sup>2</sup> every year.
- 10. Be a part of the solution. Learn more at [aninconvenienttruth.co.uk](http://aninconvenienttruth.co.uk)**

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**Pledge**

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**aninconvenienttruth**  
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