

# Global Warming and Climate Change

Miller Chapter 20

---

---

---

---

---

---

---

---

**“The IPCC’s conclusion that most of the observed warming of the last 50 years is likely to have been due to the increase in GHG concentrations accurately reflects the current thinking of the scientific community on this issue.”**

Climate Change Science  
National Academy of Sciences

---

---

---

---

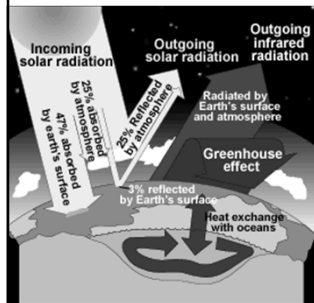
---

---

---

---

## Solar Energy Balance



Clouds?

How influential is the Ocean?

Entire atmosphere =  
3 meters of ocean surface

**Thermohaline  
Circulation**

---

---

---

---

---

---

---

---

## Major findings by the IPCC

- ⊛ Between 1970 and 2004 there was a 70% increase in GHG's, CO<sub>2</sub> grew by about 80%.
- ⊛ Largest growth of CO<sub>2</sub>
- ⊛ Methane rose by
- ⊛ Nitrous oxide N<sub>2</sub>O rose by

---

---

---

---

---

---

---

---

## Climate Change

- A natural phenomenon.
- The last ice age was
- We currently live in an period, fairly stable climate and average global surface temperatures

---

---

---

---

---

---

---

---

## What tools tell us about the past temperature and carbon dioxide readings?

- ⊛ Radioactive
- ⊛ Plankton and radioactive isotopes in marine sediment
- ⊛ Ice bubbles in ice cores
- ⊛ De
- ⊛ Pollen at the bottom of lakes and bogs

---

---

---

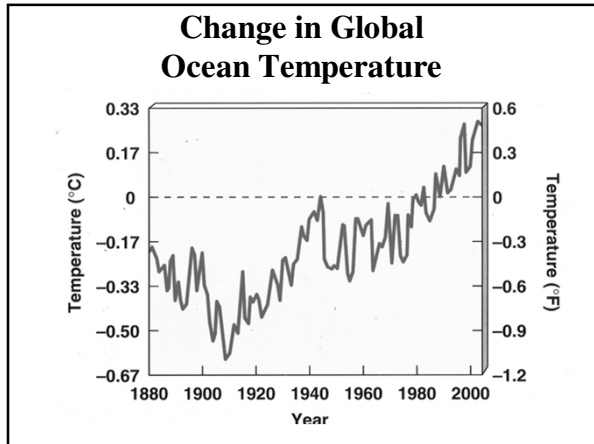
---

---

---

---

---




---

---

---

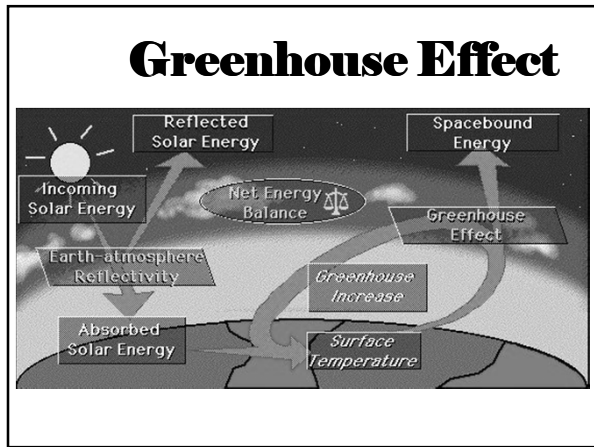
---

---

---

---

---




---

---

---

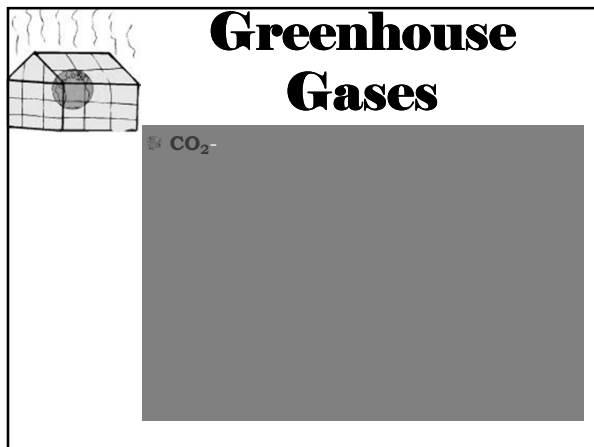
---

---

---

---

---




---

---

---

---

---

---

---

---

## Carbon Dioxide and Ice Core Samples

- ▶ The study of ice core samples from Greenland and Antarctic ice sheets shows the level of carbon dioxide in ancient air.
- ▶ The cores show that the atmosphere contained 40% less CO<sub>2</sub> when the layers of ice reached their maximum extent 20,000 years ago than it did prior to the Industrial Revolution in the 18<sup>th</sup> century
- ▶ Estimates suggest that the reduced CO<sub>2</sub> may account for nearly half of the 10°F global cooling during this glacial maximum

---

---

---

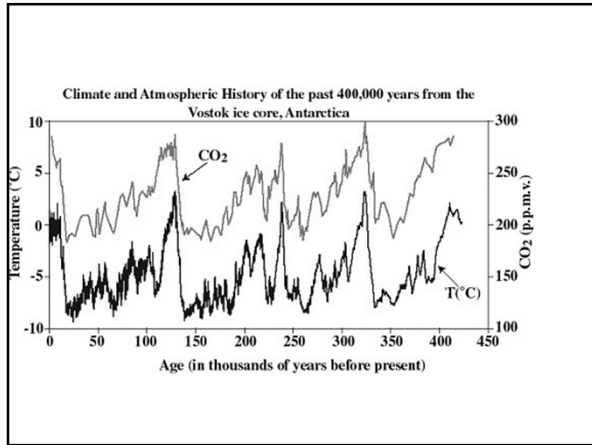
---

---

---

---

---




---

---

---

---

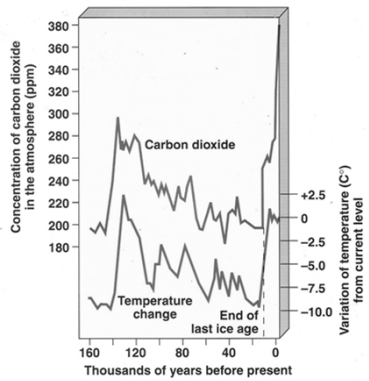
---

---

---

---

## Carbon dioxide vs. temperature




---

---

---

---

---

---

---

---

**Pre-industrial CO<sub>2</sub>  
was**

---

---

---

---

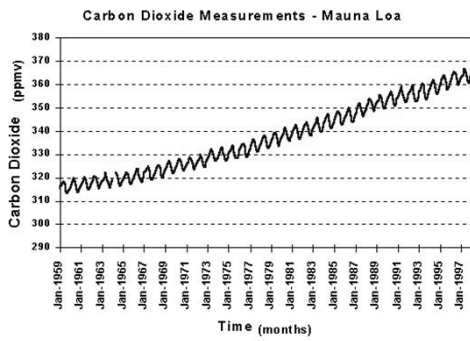
---

---

---

---

**WHAT CAUSES THE  
SEASONAL FLUCTUATIONS?**



---

---

---

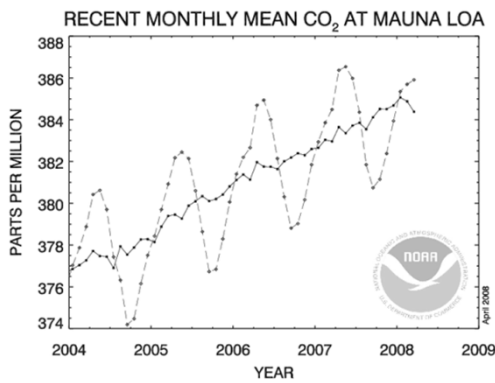
---

---

---

---

---



---

---

---

---

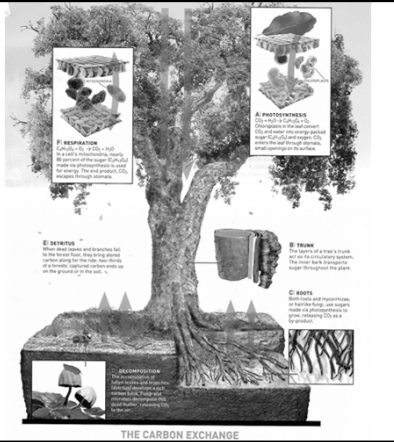
---

---

---

---

How Carbon travels in a tree,




---

---

---

---

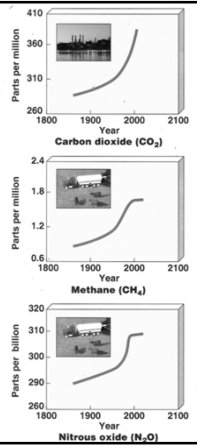
---

---

---

---

**Increase in greenhouse gas concentration 1800 to 2000**




---

---

---

---

---

---

---

---

**Kyoto Protocol**

- An international treaty that seeks to reduce the emissions of carbon dioxide and five other greenhouse gases, or to allow countries to engage in emissions trading.
- First negotiated in December 1997 ratified on November 18, 2004, when Russia signed the agreement
- Notable exceptions are the United States and Australia

---

---

---

---

---

---

---

---

## Aerosols contribute to climate change

---

---

---

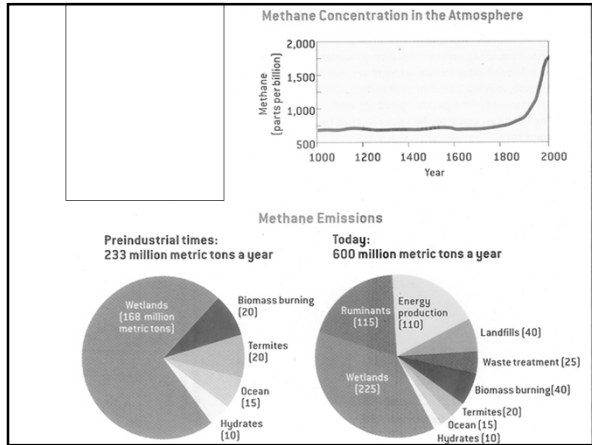
---

---

---

---

---



---

---

---

---

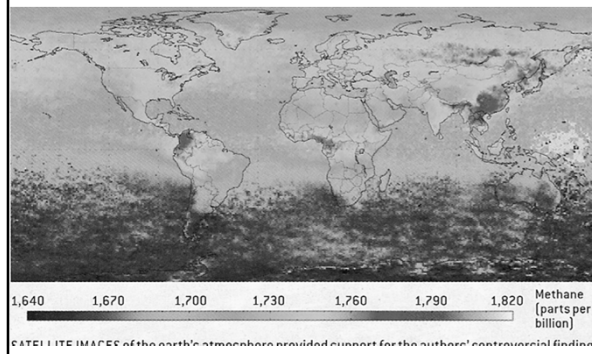
---

---

---

---

## Clouds of methane over tropical forests



---

---

---

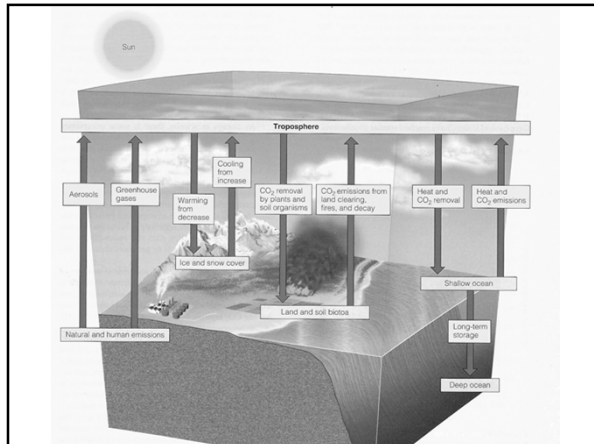
---

---

---

---

---




---

---

---

---

---

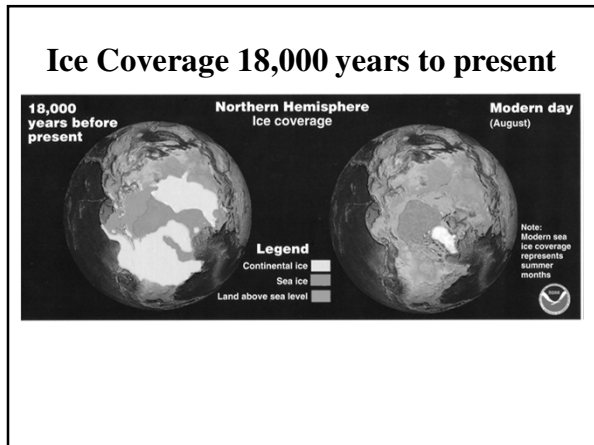
---

---

---

---

---




---

---

---

---

---

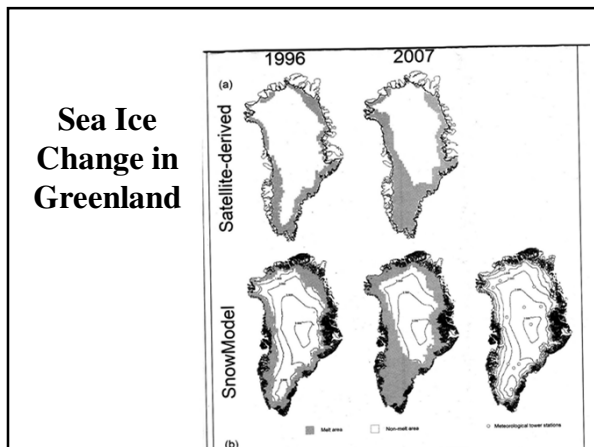
---

---

---

---

---




---

---

---

---

---

---

---

---

---

---



## Sea Level Rise in Southern California by 2100




---

---

---

---

---

---

---

---

---

---

## “Cap and Trade” Emissions Trading

- ☉ Allows companies to buy and sell "emission allowances" as long as the industry stays under a cap for total emissions of a particular pollutant
- ☉ The government establishes emission allowances, which can be bought and sold among companies
- ☉ Economists usually favor this approach since it allows market forces to work to fix environmental problems efficiently
- ☉ At the end of the year, each company must hold a number of emission allowances equal to the amount of the pollutant they emitted

---

---

---

---

---

---

---

---

---

---

## Summarizing “Cap and Trade” Emissions Trading

- ☉ Makes the most sense for pollutants where:
  - ☉ the effects are wide-ranging or global ie CO<sub>2</sub>
  - ☉ there are a large number of emission points
  - ☉ the cost of controls varies from source to source, thus providing the basis for a market to trade emission allowances
- ☉ Not all pollutants meet this test, (sulfur dioxide, mercury)
- ☉ We should always temper economists' enthusiasm for cap-and-trade schemes with proper analyses that consider ecological and human-health issues.

---

---

---

---

---

---

---

---

---

---

### Five ways to cut 1 tonC/yr in half

	1 ton carbon/yr	Cut in half	How?
a) Drive	10,000 mi, 30 mpg	60 mpg	Lighter, less power(?)
b) Drive	10,000 mi, 30 mpg	5,000 miles	Live closer to work
c) Fly	10,000 miles	5,000 miles	Video-conference
d) Heat home	Nat. gas, av. house, av. climate	Insulate, double-pane windows, fewer leaks, condensing furnace,	
e) Lights	300 kWh/month if all power is from coal (600 kWh/month, NJ)	If all-coal power, permanently replace twenty 60W incandescent bulbs, lit 6 hrs/day, with CFLs.	

---

---

---

---

---

---

---

---

### The predicted change in global surface temperature by the end of the century ranges between

This warming is larger  
over higher latitude than lower latitudes  
Larger over land than sea

---

---

---

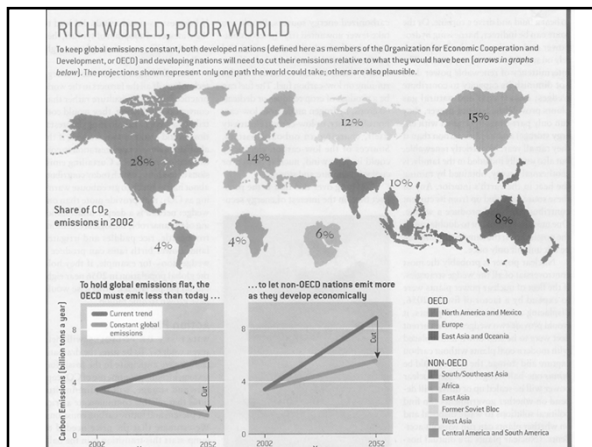
---

---

---

---

---




---

---

---

---

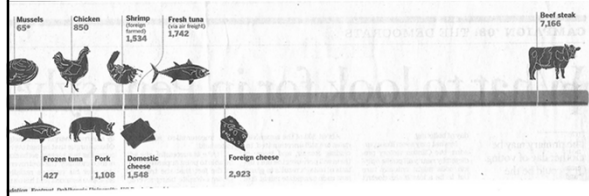
---

---

---

---

## Carbon print of various food sources



---

---

---

---

---

---

---

---