Class 14b: Global climate change

- Basics of global warming
- Potential effects
- Politics of global warming

Greenhouse effect

- Natural warming effect
- Keeps Earth habitable
- Greenhouse gases (GHGs)
  - Let in short wavelengths
  - Trap long wavelengths

What is global warming?

- Global = worldwide, not universal
- “Global climate change” more accurate
- Increase in average world temperature
- Many varied regional effects

Climate research

- How do we know about past climates?
- Temperature records
- Observations of seasons, crops
- Pollen in lake sediments
- Tree rings
- Ice cores (trapped air)

Is global warming happening?

- 1990s: warmest decade of millenium
  - 7 warmest years on record
- Increase of 1.4°F in 20th century
- Temperate latitudes: 5° increase in 35 years

Is global warming unusual?

- Fastest rate of warming in 1,000 years
- 1°C away from warmest in 125,000 years
- Highest CO_2 in 420,000 years
- Yes, it's been this warm before
- But that doesn't mean it's not serious!

What's causing global warming?

- Sunspot cycles?
  - Not since 1980s
- Earth's changing orbit?
  - Recent changes don't fit
- End of an Ice Age?
  - Maybe a little

What's causing global warming?

- Carbon dioxide, water vapor, methane
- Naturally occurring, but increase with human activity
- Rising CO_2 since Industrial Revolution
- Product of fossil fuels
- 90-99% confidence (IPCC)

How much more warming?

- 2.5° - 10°F by 2100; 5.4°F at current emission rates
- A 5°F drop led to the last ice age
- Climate systems are nonlinear
- Earth with a fever

So what for the weather?

- More climatic variability
- More and stronger storms
  - Increase in extreme weather since 1970s
  - 90% positive from global warming
- More rain in some places, less in others

So what for ecosystems?

- Northward climate shift of 90-350 miles
- Fastest species migrate at 1.2 miles/year
- Need 0.9-3.4 miles/year
- Penguins and polar bears?
- More dead plants → more CO_2 emissions
- Good for mosquitoes! And diseases

So what for the oceans?

- Thermal expansion of warmer water
- Melting ice sheets, glaciers
- Rise of 1.5-3 feet by 2100
- Every foot up is 100 feet inland
- Increased salinity in groundwater

So what for the oceans?

- Arctic Ocean ice sheet down 40% in 30 years
- Could stop the Gulf Stream
- Coral reefs very sensitive to temperature
- Mass die-offs worldwide since 1979

So what for cities?

- More air pollution
- More deadly heat waves
- Mountain glaciers disappearing, too
- Water supplies for millions in danger
- Sea level rise: New York, London, Bangkok, Rio, etc.

So what for countries?

- Some positive effects in North
- Greatest threats to poorest countries
- Most emissions from wealthy countries
- 40 countries in danger of annihilation

Solutions to global warming

- Mitigation: reduce effects
  - Carbon taxes
  - Emissions trading
  - Energy efficiency, alternative fuels
- Adaptation: adapt to effects
  - Seawalls, irrigation, etc.
  - No matter the cause; but who pays?

Politics of global warming

- Fossil-fuel producers: little to nothing
  - US, Australia, Saudi Arabia, etc.
  - US has 4% of population, 36% of CO_2 emissions
- Europe: has set binding targets
- Developing countries: want to develop
- Small island states: want to exist

Politics of global warming

- Kyoto Protocol (1997)
  - Ratified by Europe, Russia, not US
  - Cuts of 7% from 1990 levels
  - Est. 50-70% cuts needed to stabilize CO_2
- Est. cost: $270-450 billion for U.S.
- About the same as mitigation

IPCC Projections

(IPCC Third Assessment, 2001)[6]

- Average global temperatures will increase between 1.4 to 5.8 °C (2.5 to 10.4 °F).
- More El Niño-like warming in the eastern tropical Pacific, and greater extremes of drying and heavy rainfall.
- Increased precipitation over northern mid to high latitudes and in Antarctica, with larger year-to-year variations worldwide.
- Weakening of ocean circulation patterns which bring warm tropical waters to high latitudes in the Northern Hemisphere.
- Northern Hemisphere snow cover, glaciers, ice caps and sea ice are projected to decrease. However, Antarctica is likely to gain mass.
- Global mean sea level is projected to rise by 0.09 to 0.88 meters (3.5 to 35 inches), primarily due to thermal expansion and glacial and ice sheet melting. (This figure is actually slightly lower than the 1992 scenarios predicted, due primarily to more precise modeling.)