Overview of Climate Science and Policy

EES 3310/5310

Global Climate Change

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Class #2: Wednesday, January 27 2021

Housekeeping

Remember when you email me to include “EES 3310” or “EES 5310” in your subject line.

Aral Sea

a.
KAZAKHSTAN
Aral Sea
UZBEKISTAN
0 20 40 Kilometres
Sept 1977
b.
KAZAKHSTAN
Aral Sea
UZBEKISTAN
0 20 40 Kilometres
Apr - Jun 1986
c.
North Aral Sea
KAZAKHSTAN
South Aral Sea
Aral-kum
South Aral Sea
UZBEKISTAN
0 20 40 Kilometres
Jul - Oct 1999
d.
North Aral Sea
KAZAKHSTAN
Kok-Aral Dam
South Aral Sea
Aral-kum
South Aral Sea
UZBEKISTAN
0 20 40 Kilometres
Jul - Sep 2006
e.
North Aral Sea
KAZAKHSTAN
Kok-Aral Dam
South Aral Sea
Aral-kum
South Aral Sea
UZBEKISTAN
0 20 40 Kilometres
Jun 2009
f.
North Aral Sea
KAZAKHSTAN
South Aral Sea
Aral-kum
South Aral Sea
UZBEKISTAN
0 20 40 Kilometres
Jun 2013

Questions from Reading?

Important Concepts:

Important Concepts:

- What kinds of things can cause the global temperature to change?
  - Energy Balance:
    - Temperature is steady when $\mathbf{Heat}_{\mathbf{in}} = \mathbf{Heat}_{\mathbf{out}}$.
  - What happens when $\mathbf{Heat}_{\mathbf{in}} > \mathbf{Heat}_{\mathbf{out}}$?
  - What kinds of things can cause $\mathbf{Heat}_{\mathbf{in}}$ to change?
  - What kinds of things can cause $\mathbf{Heat}_{\mathbf{out}}$ to change?

Temperature Change

- How much has earth warmed in the last century or so?
  - About 1.0°C (1.8°F)
- If CO_2 emissions keep rising on their current path, how much do scientists expect it to warm in the next century?
  - Somewhere around 3–6°C (5–11°F)
- What is the seasonal temperature change in Nashville (winter to summer)?
  - Around 23°C (42°F) 47°F in January, 89°F in August.
- What is the average daily temperature range in Nashville (night to day)?
  - Around 11°C (20°F)
- **So why do people worry about global warming?**

Predictions

- Meteorologists can’t predict whether it will rain three weeks from today with any confidence.
- So how can I trust predictions about the climate 100 years from now?

Economy-Energy-Environment

Wealth & Energy Use

Wealth & CO_2 Emissions

US Emissions

- 5 billion metric tons CO_2 per year total
- 15 metric tons CO_2 per person per year
- 25 pounds carbon per person per day

Economics, Policy, Climate

- Why don’t markets manage greenhouse gas emissions well?
  - Pollution is an **externality**
- How does Nordhaus propose to fix this problem?
  - Ronald H. Coase (1920–2013):
    - Solve externality problems by assigning property rights
      - Cap-and-trade: Permits
      - Emissions tax: Put price on emissions

Ronald H. Coase

Economics and Vulnerability

Breakout Room Discussion (5 minutes)

- Can you think of examples of **managed**, **unmanaged**, and **unmanageable** resources?
- How would you respond to climate change differently for the 3 kinds of resources?

What Earth’s History Tells Us

800,000 years of CO_2

800,000 years of CO_2 and Temperature

Using Past Climates to Test Theory

Source: J. Hansen *et al.*, Phil. Trans. Roy. Soc. A **371**, 20120394 (2013).

Tipping Points

Tipping Points

- Consider a wooden stick
- Bend it a little
  - When you let it go, it springs back to its original shape
- Bend it too far
  - It snaps
  - When you let it go, it does not return to its original shape

Amplification of Climate Change

Climate Tipping Points

- Unknown, uncertain, but dangerous
- We may have crossed a tipping point in sea-level rise
  - West Antarctic ice sheet may be past saving
- Less likely:
  - Runaway warming
    - Temperature rises
    - Biomass in Arctic tundra thaws and decays
    - Releases methane & CO_2
    - Further warming
- Climate tipping points:
  - We don’t know if they exist
  - We don’t know where they are
  - How do we make policy for those risks?