

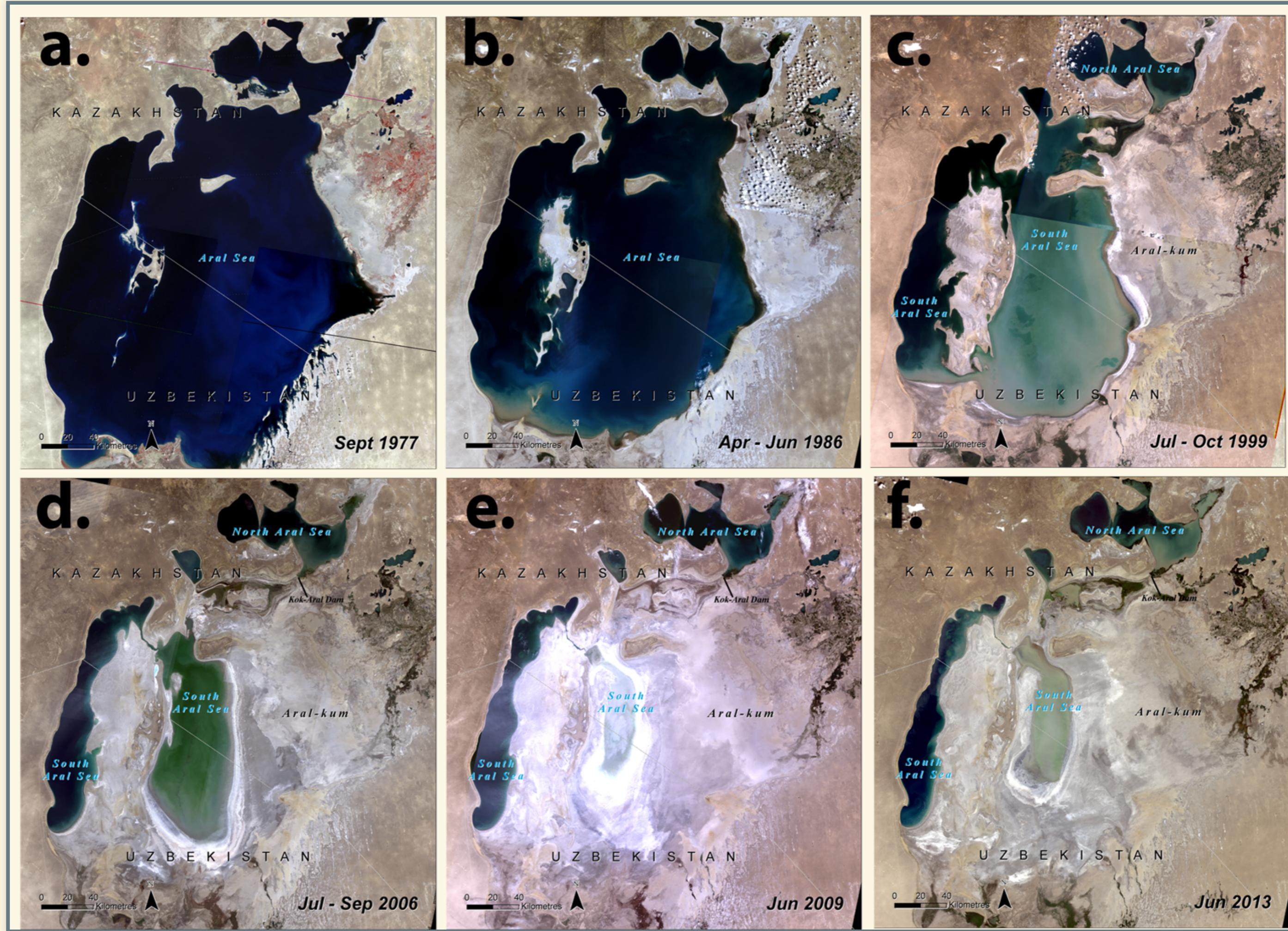
# Overview of Climate Science and Policy

EES 3310/5310  
Global Climate Change  
Jonathan Gilligan  
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



# Questions from Reading?

# Important Concepts:

# Important Concepts:

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

# Temperature Change

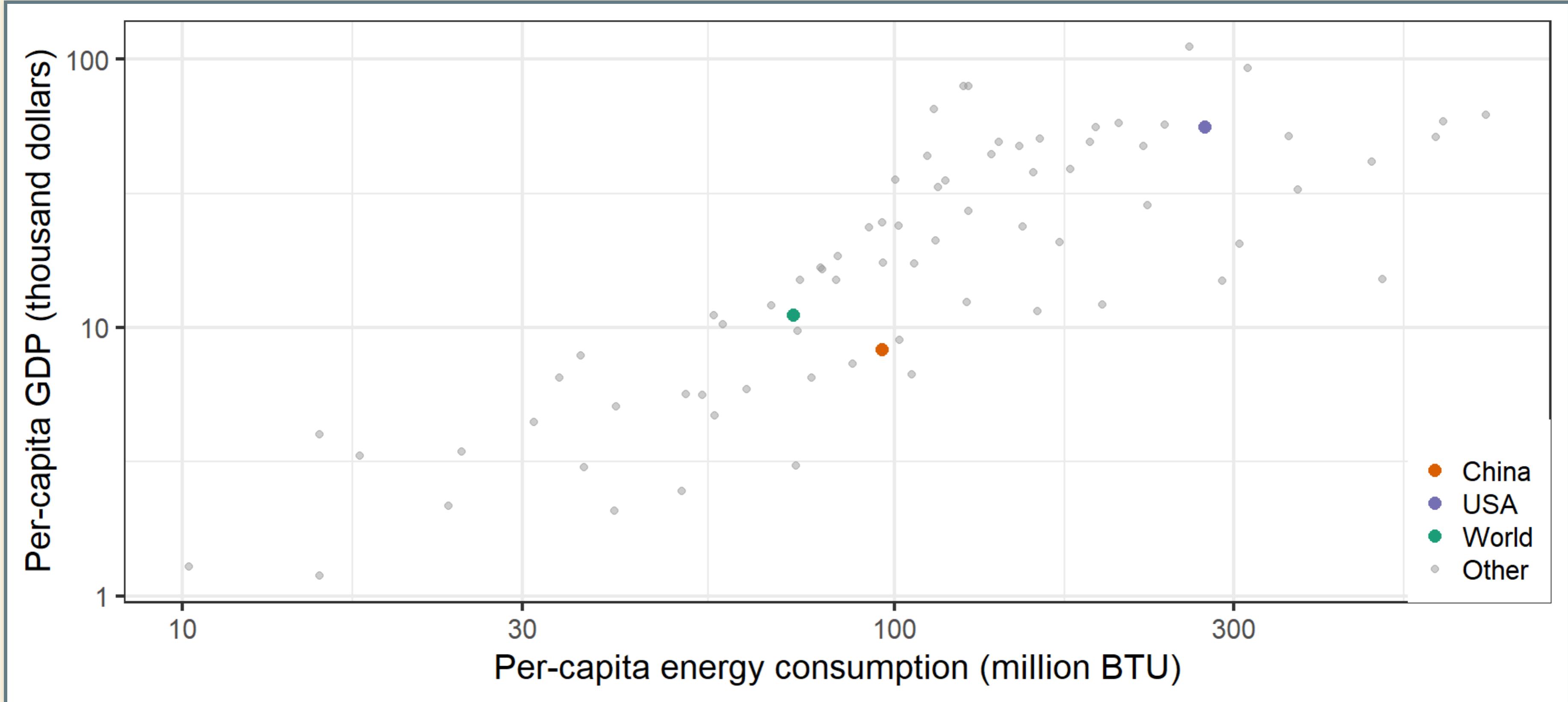
- How much has earth warmed in the last century or so?
  - About  $1.0^{\circ}\text{C}$  ( $1.8^{\circ}\text{F}$ )
- If  $\text{CO}_2$  emissions keep rising on their current path, how much do scientists expect it to warm in the next century?
  - Somewhere around  $3\text{--}6^{\circ}\text{C}$  ( $5\text{--}11^{\circ}\text{F}$ )
- What is the seasonal temperature change in Nashville (winter to summer)?
  - Around  $23^{\circ}\text{C}$  ( $42^{\circ}\text{F}$ )  $47^{\circ}\text{F}$  in January,  $89^{\circ}\text{F}$  in August.
- What is the average daily temperature range in Nashville (night to day)?
  - Around  $11^{\circ}\text{C}$  ( $20^{\circ}\text{F}$ )
    - **So why do people worry about global warming?**

# Predictions

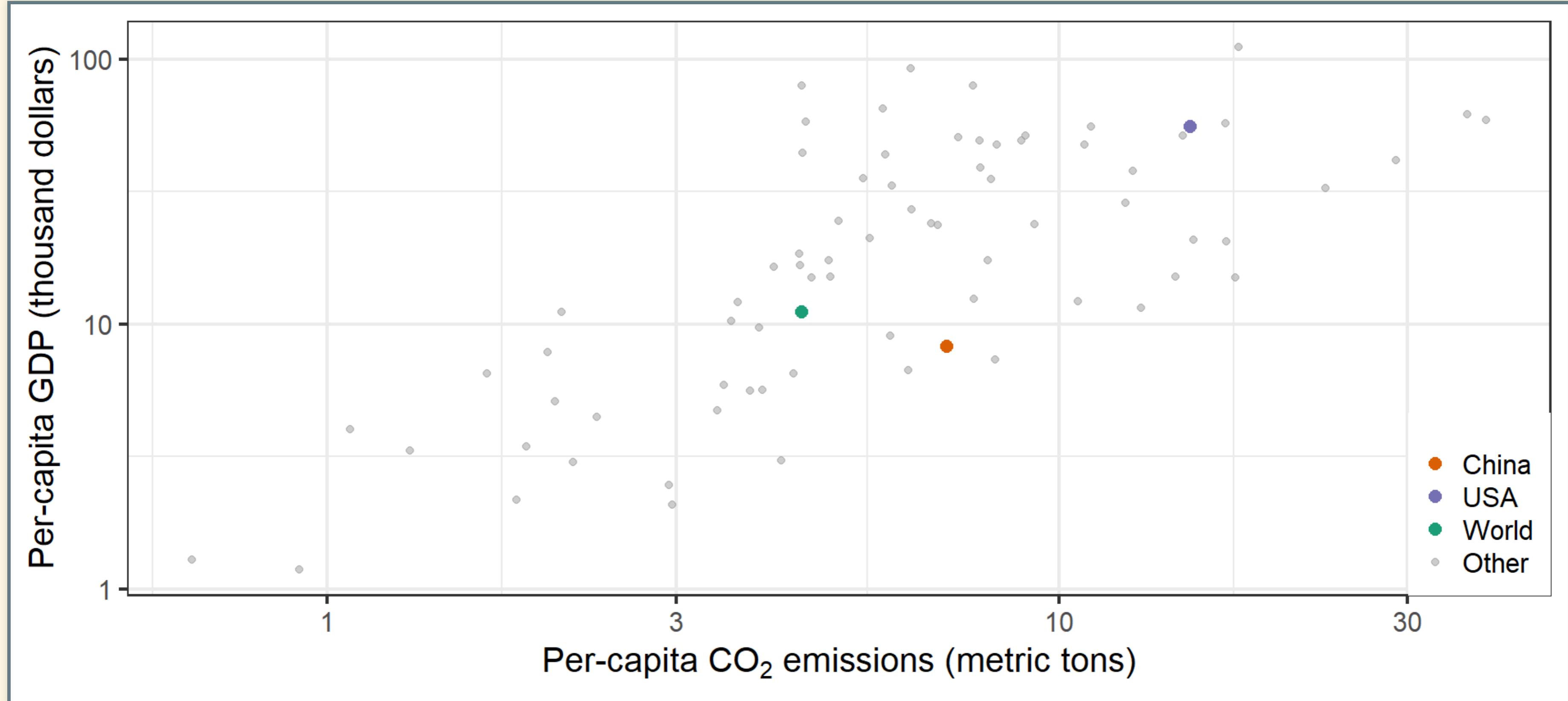
- Meteorologists can't predict whether it will rain three weeks from today with any confidence.
- So how can I trust predictions about the climate 100 years from now?

# Economy-Energy-Environment

# Wealth & Energy Use



# Wealth & CO<sub>2</sub> Emissions



# US Emissions

- 5 billion metric tons CO<sub>2</sub> per year total
- 15 metric tons CO<sub>2</sub> 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

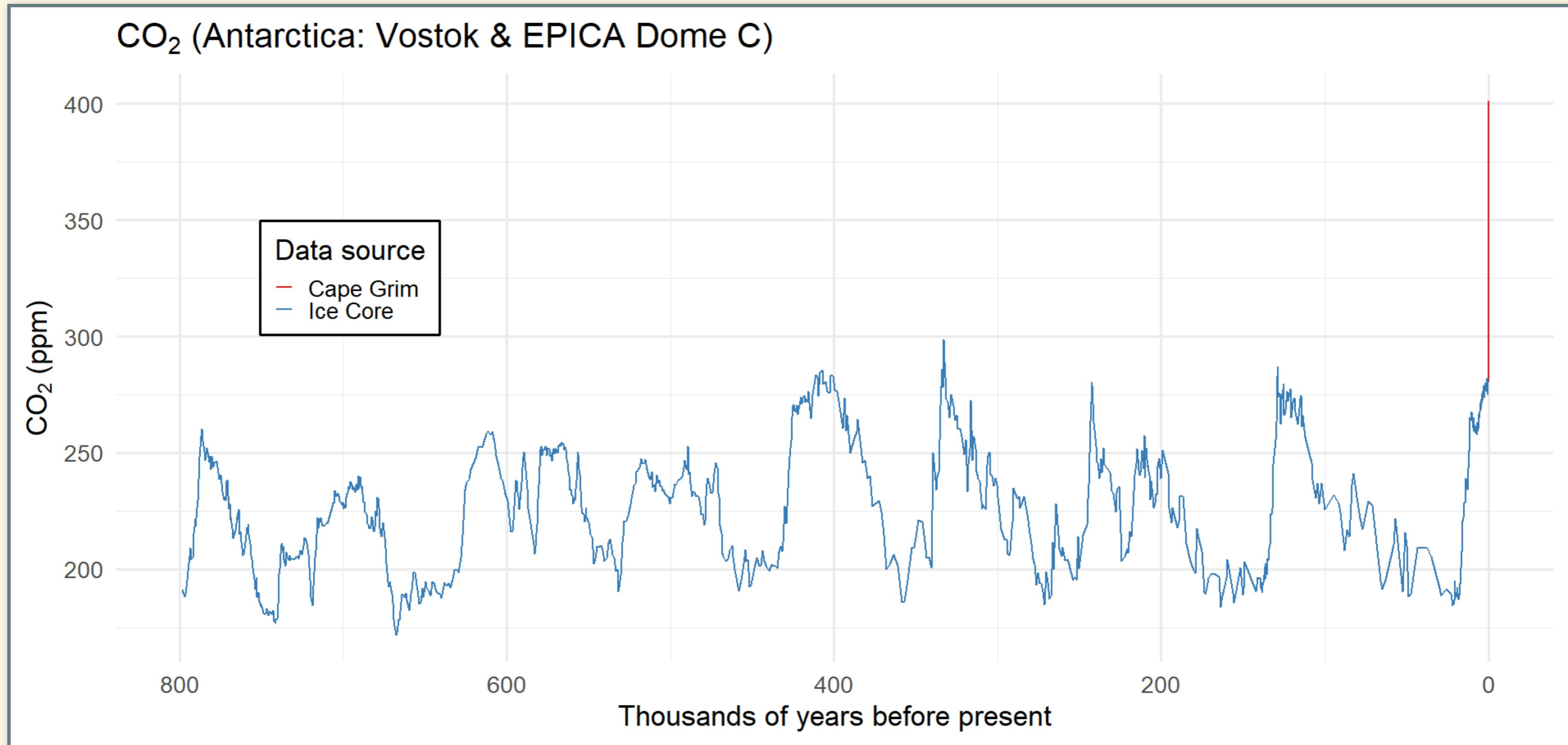
## Breakout Room Discussion (5 minutes)

- 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?

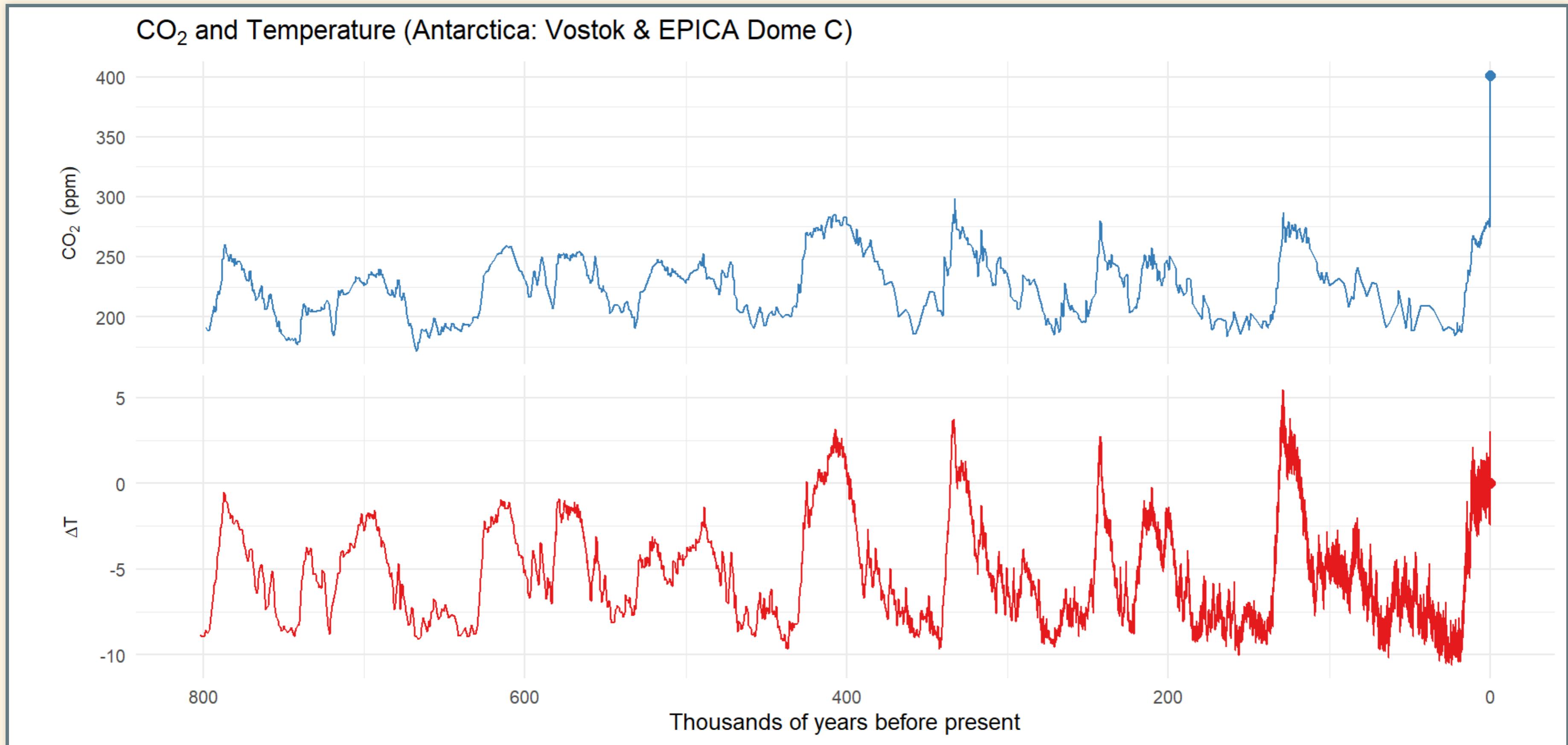


# What Earth's History Tells Us

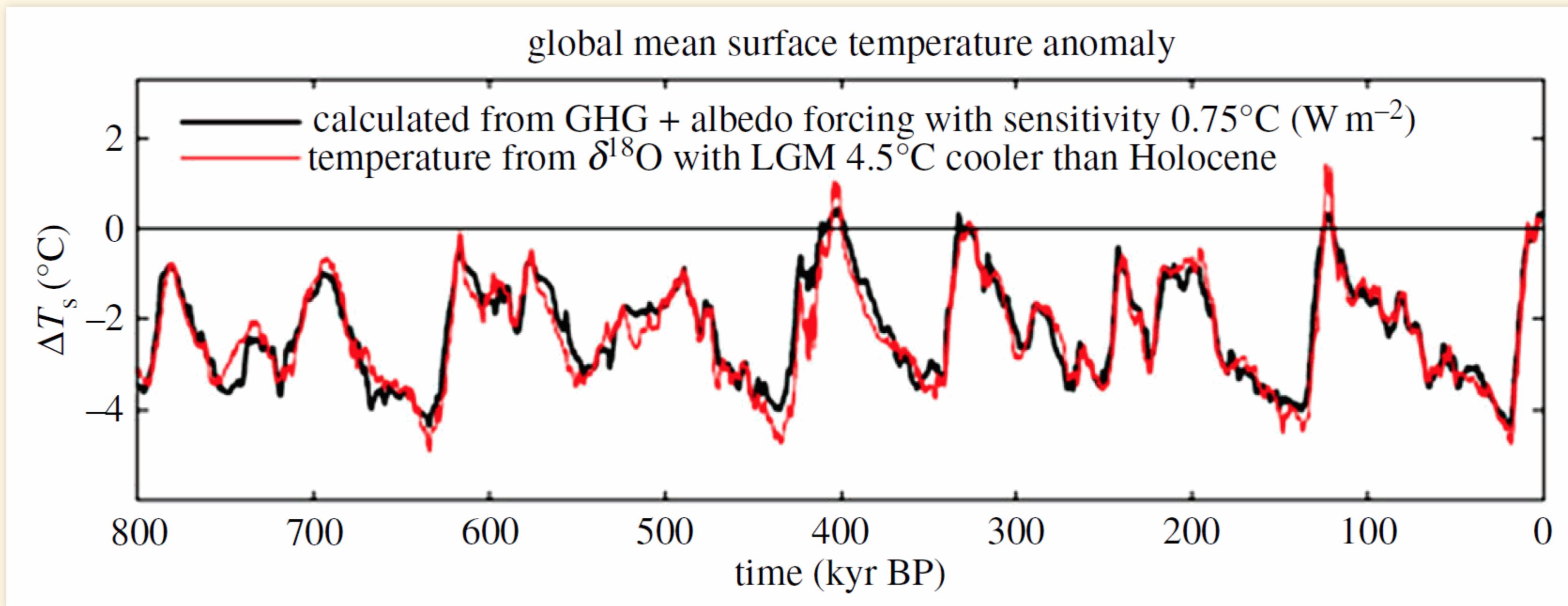
# 800,000 years of CO<sub>2</sub>



# 800,000 years of CO<sub>2</sub> and Temperature



# Using Past Climates to Test Theory



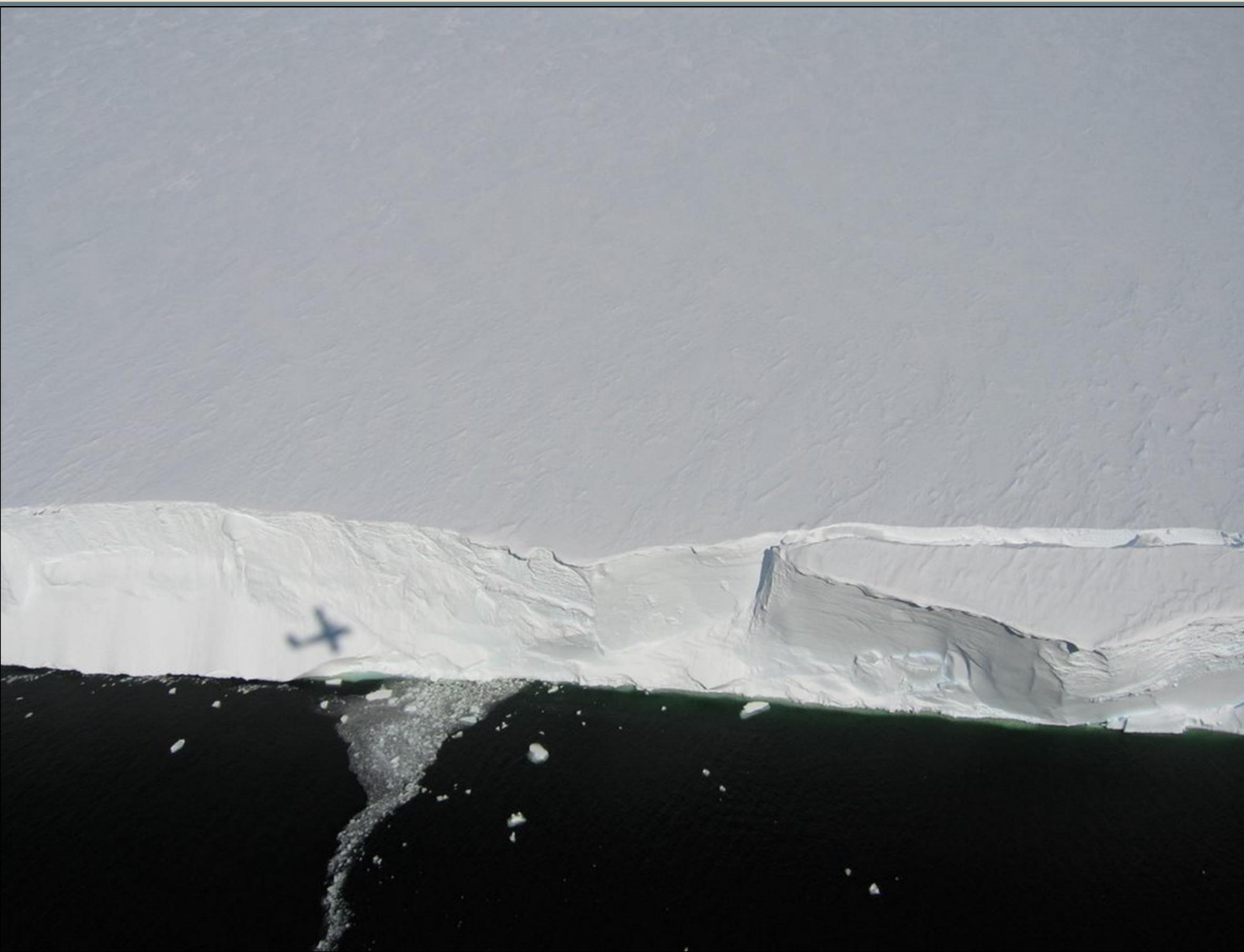
Source: J. Hansen *et al.*, Phil. Trans. Roy. Soc. A **371**, 20120394 (2013).

# 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<sub>2</sub>
    - 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?