

---

# Climate Change: An Inter-disciplinary Approach to Problem Solving (AOSS 480 // NRE 480)

Richard B. Rood  
Cell: 301-526-8572  
2525 Space Research Building (North Campus)  
[rbrood@umich.edu](mailto:rbrood@umich.edu)  
<http://aoss.engin.umich.edu/people/rbrood>

Winter 2015  
February 26, 2015

## Class Information and News

---

- Ctools site: [AOSS SNRE 480 001 W15](#)
  - Record of course
- Rood's [Class MediaWiki Site](#)
  - [http://climateknowledge.org/classes/index.php/Climate\\_Change:\\_The\\_Move\\_to\\_Action](http://climateknowledge.org/classes/index.php/Climate_Change:_The_Move_to_Action)

# Resources and Recommended Reading

---

- Reading to understand relation of science to policy
  - [Jasanoff: The Fifth Branch \(Chapter 1\)](#)
- Foundational References
  - [UNFCCC: Text of Convention](#)
  - [Kyoto Protocol: Text](#)
  - [Kyoto Protocol: Introduction and Summary](#)
  - [Millennium Ecosystem Assessment](#) Web Portal

## Resources and Recommended Reading

---

- Socolow and Pacala, “Stabilization Wedges,” *Scientific American*, 2006 ([link](#))
- Other versions, additional reading
  - Pacala and Socolow, “Stabilization Wedges,” *Science*, 2004 ([link](#))
  - Socolow, “Wedges Reaffirmed,” *Climate Central*, 2011 ([link](#))
  - Blog at *climateprogress* ([link](#))

## Wedges on the Web

---

- [Carbon Mitigation Initiative](#) @ Princeton University

## Outline: Class 15, Winter 2015

---

- Why Policy?
- Global Mitigation Policy
- Conference of the Parties
- Assessment
- Kyoto Protocol

# A global perspective on energy and climate

---

To achieve stabilization at a 2°C warming, we would need to install  $\sim 900 \pm 500$  MW [mega-watts] of carbon emissions-free power generating capacity each day over the next 50 years. This is roughly the equivalent of a large carbon emissions-free power plant becoming functional somewhere in the world every day. In many scenarios, this pace accelerates after mid-century. . . even stabilization at a 4°C warming would require installation of 410 MW of carbon emissions-free energy capacity each day.

[Caldeira et al. 2003](#)

# Policy

- What do we look to policy to accomplish?
  - Some common, relevant purposes of policy
    - Stimulate technology: Provide incentives or disincentives for behavior. (Often through financial or market forces.)
    - Set regulations: Put bounds on some type of behavior, with penalties if the bounds are exceeded.
    - Make internal some sort of procedure or behavior or cost that is currently external.
  - A more abstract point of view
    - Represents collective values of society: what is acceptable and what is not.
    - Interface with the law?
    - Provides the constraints and limits, the checks and balances in which we run our economy.



# Policy-climate science interface (1)

- It is sensible to look at governance and policy to address climate change
  - It's a “greater good” problem
  - It relates to natural resources and waste from the use of natural resources
  - It matters to economic and national security
  - There is precedence (Ozone and Acid Rain)
- Given the relation to energy and wealth it is natural to expect there will not to be a “one size fits all solution” for climate change.
  - One size fits all is one of the most common traps that “managers” and “leaders” fall into.
    - Feeds polarization and rhetoric
    - Guided to one size by political interests

## Policy

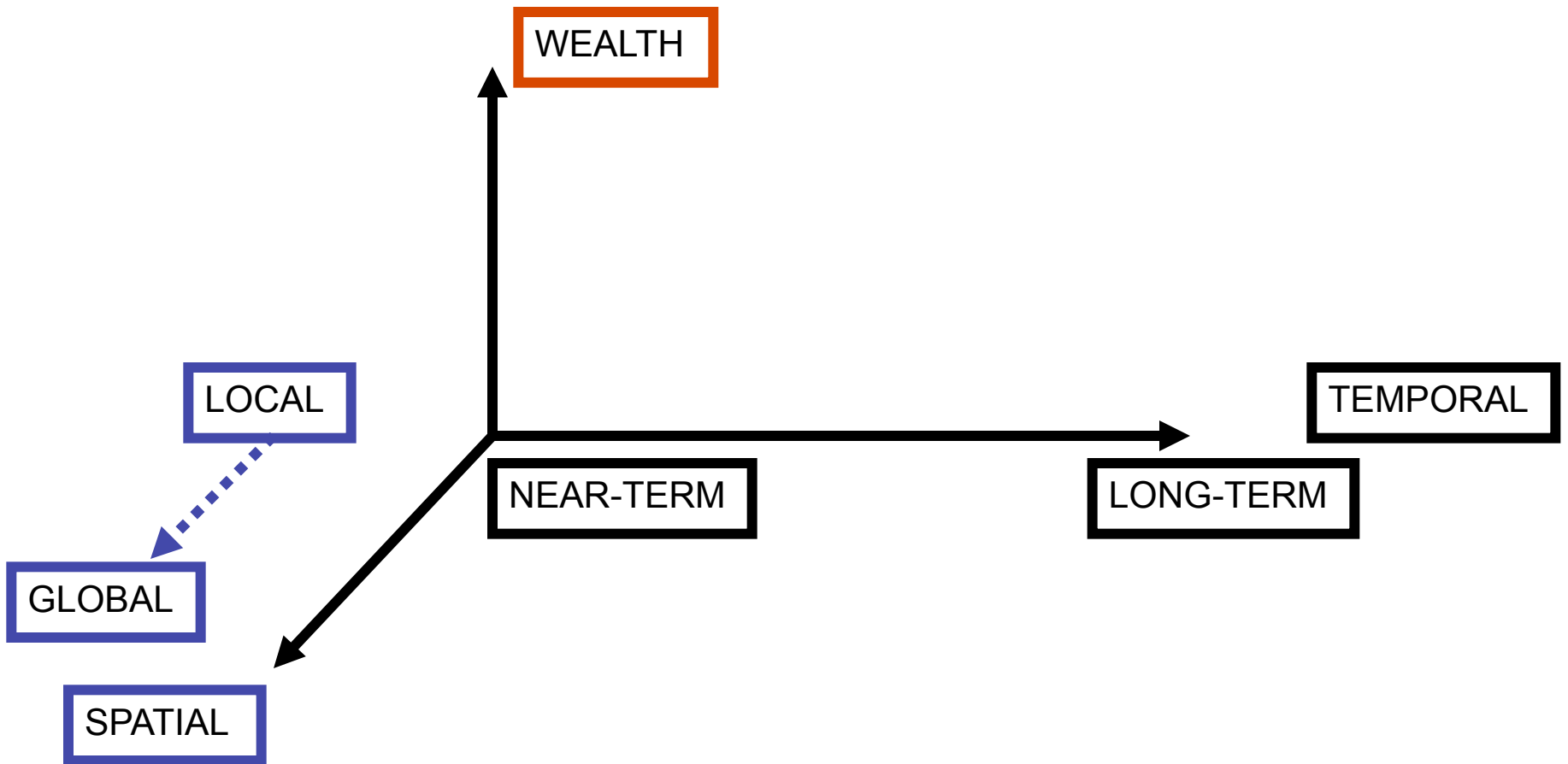
---

- A natural reaction to greenhouse gas emissions is to look to government, to the development of policy to address the problems that we are faced with.
  - Originally policy focus was mitigation, reduce emissions, keep dangerous global warming from happening.
  - Often when people talk policy, they mean mitigation

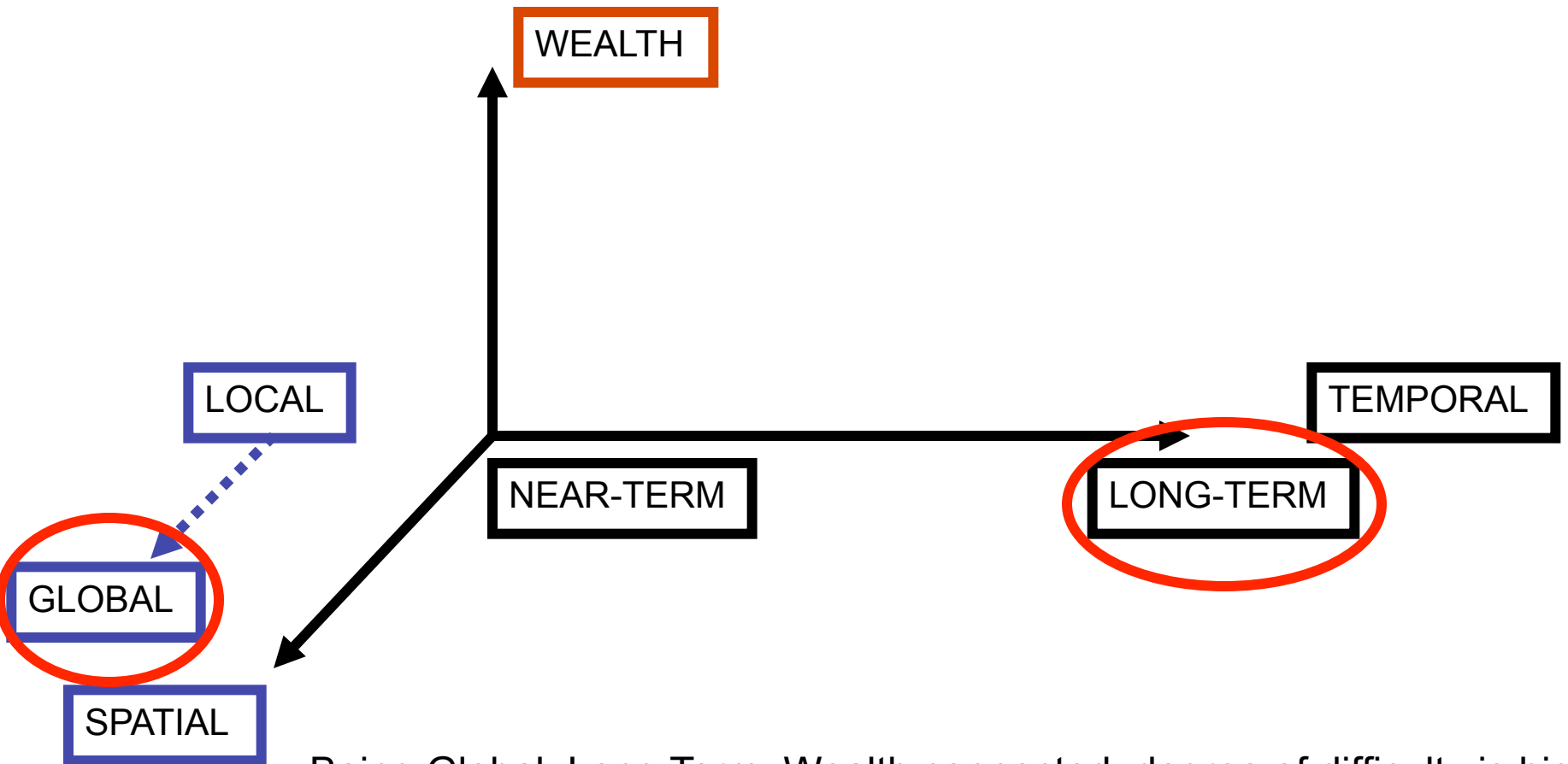
# Global Mitigation Policy

---

# Managing Climate Complexity

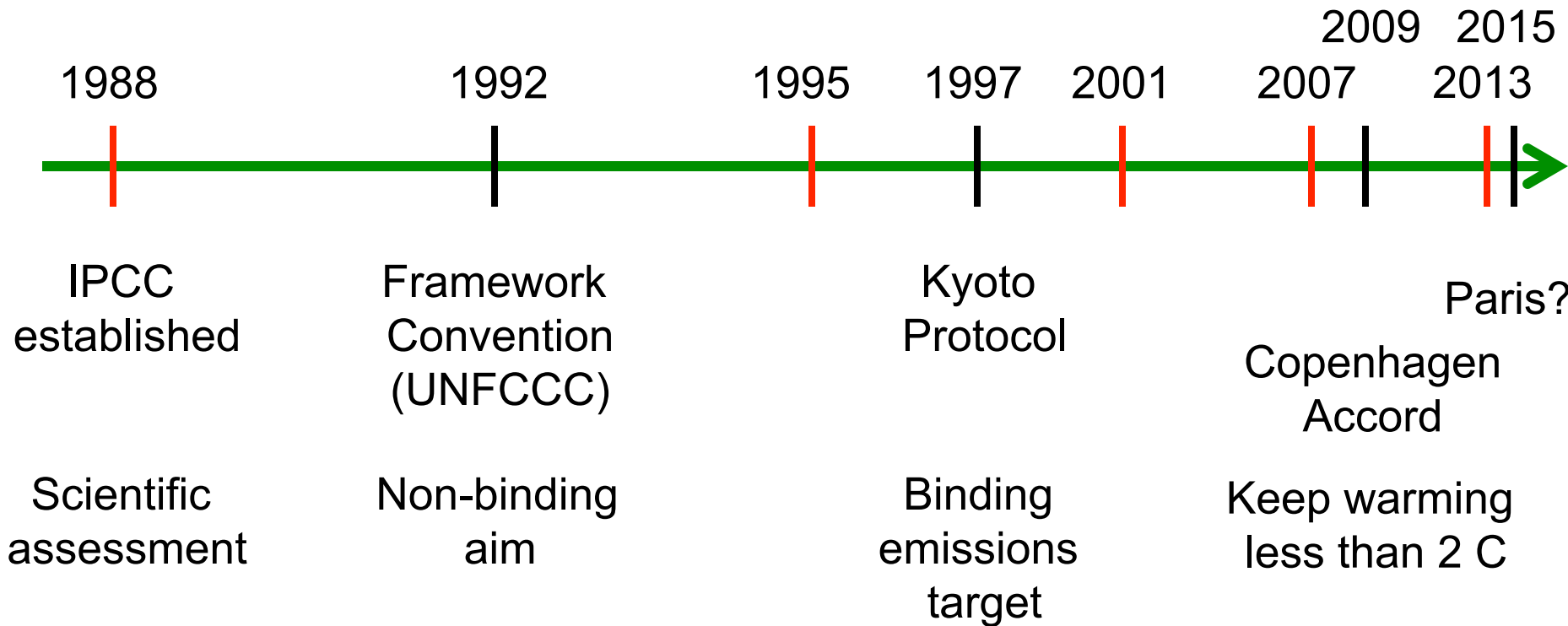


# Managing Climate Complexity



Being Global, Long Term, Wealth connected, degree of difficulty is high

## Development of International Approach to Climate Change



## The Official Policy is:

---

- United Nations Framework Convention on Climate Change
  - [Framework Convention on Climate Change](#)

## Framework Convention on Climate Change (US in part of this.)

---

- UN Framework Convention on Climate Change (1992, non-binding, voluntary, 192 signers)
  - Reduce CO<sub>2</sub> Emissions in 2000 to 1990 levels
  - Inventories of greenhouse gas emissions
  - Mitigate Climate Change



## 1992 Convention Commitments

---

- **All Parties agree to:**
  - 4.1.b. **Mitigate emissions and enhance sinks**
  - 4.1.c. **Promote technology development and transfer**
  - 4.1.e. **Cooperate on research and observation**
- **Developed Countries' aim to return emissions to 1990 levels by the end of the century**

# Framework Convention on Climate Change

- Ultimate Objective of the UNFCCC (Article 2)

“...**stabilization** of greenhouse gas concentrations in the atmosphere at a level that would prevent **dangerous** anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to:

- allow **ecosystems** to adapt naturally to climate change;
- ensure that **food production** is not threatened; and
- enable **economic development** to proceed in a sustainable manner.

# Dangerous climate change?

---

- What is dangerous?

# Conference of the Parties

---

## What is COP?

- COP is the Conference of the Parties
  - Parties are those countries who have signed the United Nations Framework Convention on Climate Change. There are 192 signatories.
    - Essential Background UNFCCC

# Michigan Observer Status

---

- Framework Convention Parties and Observers
  - Parties are signatories of Framework Convention
  - Observers are invited to the meeting for participation, transparency, and accountability
    - United Nations Representatives
    - Intergovernmental Organizations
    - Non-governmental Organizations
  - Virtual Participation

# Assessment

---

## Climate Assessment

---

- Perhaps the most present accomplishment of international climate change policy is assessment
  - Regular ~ 5 years assessment of the state of the knowledge
  - Provides translation of the scientific literature for policy makers



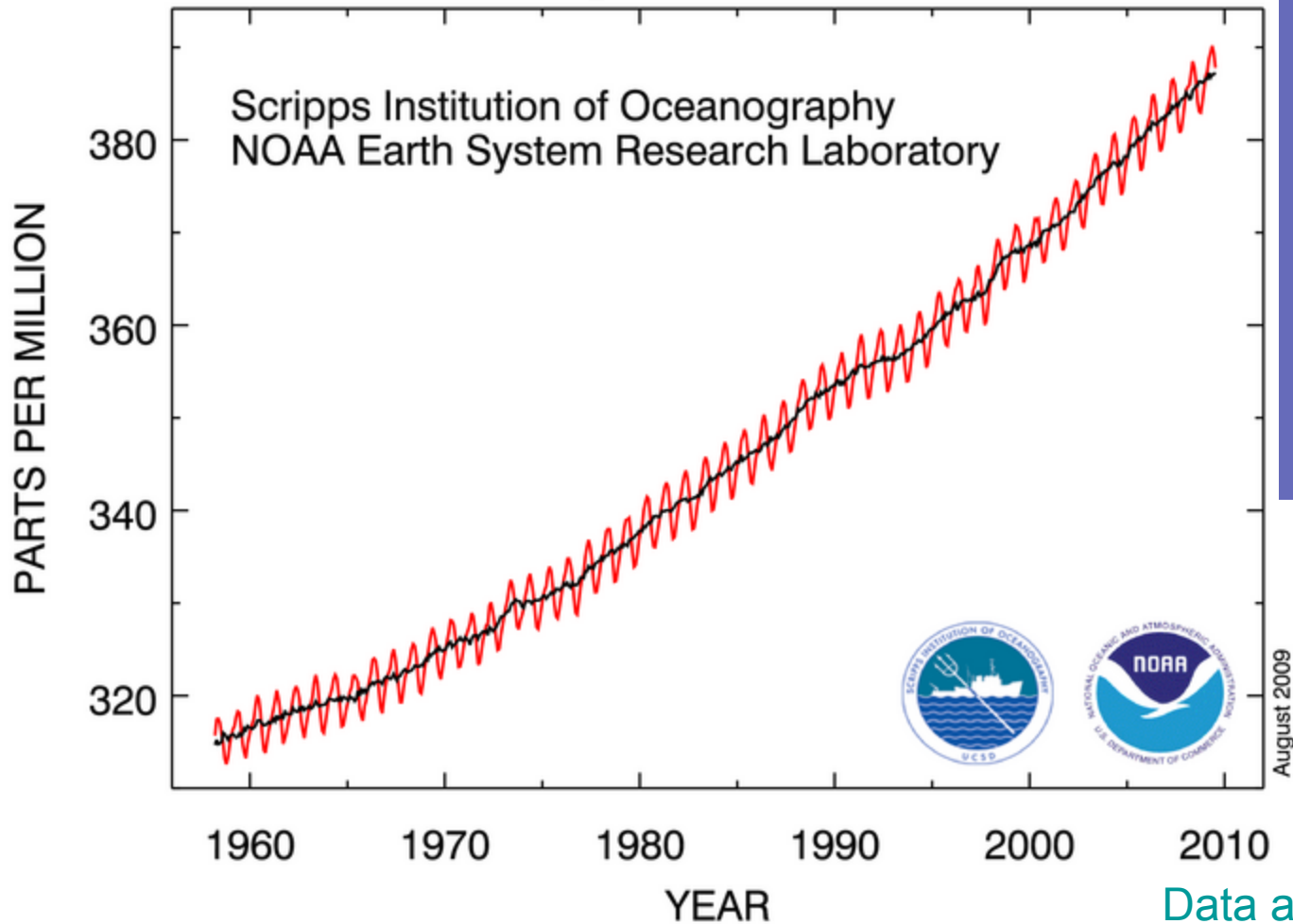
## Assessment

---

- Mid-1990' s
  - No reduction in emissions
  - Evidence of warming and impacts
- 2001
  - No reduction in emissions
  - Evidence of warming and impacts
- 2007
  - No reduction in emissions
  - Evidence of warming and impacts

## Increase of Atmospheric Carbon Dioxide (CO<sub>2</sub>)

### Atmospheric CO<sub>2</sub> at Mauna Loa Observatory



“This generation has altered the composition of the atmosphere on a global scale through...a steady increase in carbon dioxide from the burning of fossil fuels.”

--Lyndon Johnson  
Special Message  
to Congress,  
1965

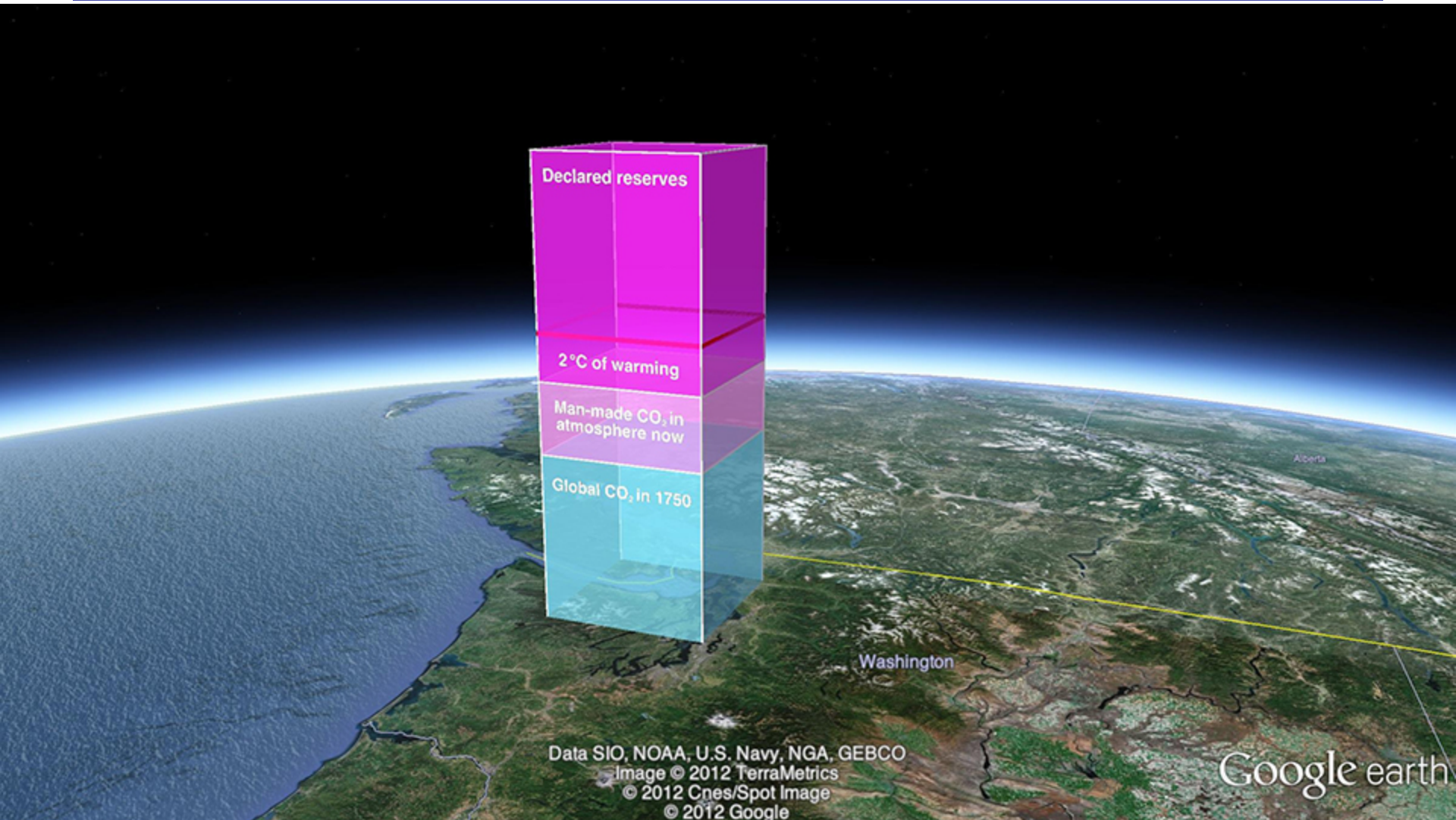
[Data and more information](#)

## A trillion tons of carbon

---

- We get to emit a trillion tons of carbon to avoid “dangerous” climate change

# Trillion Tons: Carbon Visuals



# Kyoto Protocol

---

## Kyoto Protocol

---

- Kyoto Protocol (December, 1997, binding limits on or reduction of emissions)
  - Must be signed (155 signers (?186)) and ratified
    - At least 55 countries
    - That represent 55 % or more of emissions
  - Open for signatures on March 16, 1998
  - Went into effect on February 16, 2005
    - After Russia signed and ratified

# Kyoto Protocol Requirements

- Developed nations reduce their emissions 5.2% below 1990 emissions
  - Reduction (increases) vary across countries
  - Relaxed a little over the years to attract signers
  - (Treaty: U.S. 7% reduction: Actual: 12% higher in 2004, 30% by 2012)
- Addresses “six” greenhouse gases (CO<sub>2</sub>, Methane CH<sub>4</sub>, Nitrous Oxide N<sub>2</sub>O, hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride)
- Commitment period 2008-2012
- Set of other activities
  - Improve “local emission factors”
  - Inventories of emissions and sinks
  - Mitigation and adaptation plans
  - Environmentally sound technology diffusion to developing nations

## Kyoto Protocol Issues

---

- Amount and distribution for limits and reductions
- What greenhouse gases to include
- Developing countries in or out of emission requirements
- Trading, market-based mechanisms
- Role of removing greenhouse gases



# Kyoto Protocol: Important Add ons

---

- Market-based mechanisms
  - Emissions trading
  - Joint implementation
  - Clean development mechanisms

## Flexibility in Achieving Targets

---

- “What” flexibility
  - Targets apply to CO<sub>2</sub>-equivalent emissions of basket of six GHGs
  - Can use carbon sinks (e.g. forests) as offsets
- “When” flexibility
  - Five-year commitment period
  - Banking
- “Where” flexibility
  - Market mechanisms: ET, JI, CDM

## Kyoto Protocol followed 1995 assessments

---

- Is the Kyoto Protocol still relevant?
  - It has officially expired
  - It frames much of the language we use
  - It sets a foundation for market-based approaches to climate change
  - Some countries strive to adhere to the protocol

## “Flaws” in Kyoto Protocol

---

- Participation of Developing Countries
  - Large populations, large projected growth
- Participation of the United States
  - Large portion of greenhouse gas emissions
- Other “flaws”
  - Does not go far enough: Emission goals don’t adequately mitigate dangerous climate change
  - 2008-2012 commitment period – then what?

## Summary: Class 15, Winter 2015

---

- Why Policy?
- Global Mitigation Policy
- Conference of the Parties
- Assessment
- Kyoto Protocol

## Outline: Class 15, Winter 2015

---

- Why Policy?
- Global Mitigation Policy
- Conference of the Parties
- Assessment
- Kyoto Protocol

## Appendix

---

- United Nations: How Nations Organize

## Constituencies in the community

---

- OECD:  
[Organization for Economic Co-operation and Development](#)
- Annex 1: Developed Countries and Economies in Transition
  - [List of Annex 1 countries](#)
- Annex 2: The OECD Countries
  - Provide financial and technical support to Economies in Transition
- Annex B: Annex 1 parties with emission targets
- Least Developed Countries



## Constituencies in the community

---

- “G-77” and China: ~130 developing countries, work by consensus (generally represent The Africa Group)
  - Economic development and emission limits
  - Sell their potential carbon credits for profit
- The Alliance of Small Island States (AOSIS)
  - Tightest control on global emissions
- Organization of Petroleum Export Countries (OPEC)
  - Protection of their economic well being

## Constituencies in the community

---

- European Union (EU)
  - Coordinated position as environmental leader with very ambitious emission reduction goals
- Japan, U.S., Switzerland, Canada, Australia, Norway, New Zealand (JUSSCANNZ)
  - Non-EU developed countries
  - Cost of tackling the climate problem
    - U.S., Canada, Australia: Low-efficiency energy use
    - Japan, Switzerland, Norway, New Zealand: High-efficiency energy use