

# Understanding Climate Change

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Charleston County Library

# What is Climate Change?

# Climate

*The average weather, or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period for averaging these variables is 30 years, as defined by the World Meteorological Organization. The relevant quantities are most often surface variables such as temperature, precipitation, and wind*

– Intergovernmental Panel on Climate Change (IPCC)

# Climate Change

*Any substantial change in measures of climate (such as temperature or precipitation) lasting for an extended period (decades or longer)*

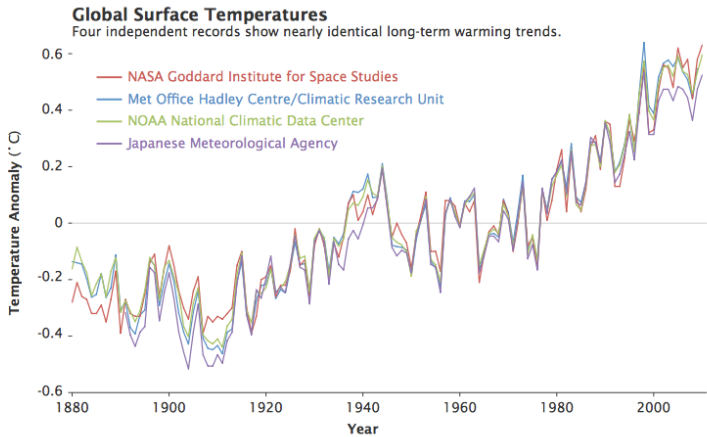
– U.S. Environmental Protection Agency

# Global Warming

*Average increase in the temperature of the atmosphere near the Earth's surface*

– U.S. Environmental Protection Agency

- The average temperature of the earth has increased about  $0.8^{\circ}\text{C}$  ( $1.4^{\circ}\text{F}$ ) since 1900
- Changes in temperature are a principal driver of other changes



Credit: NASA Earth Observatory/Robert Simmon

Data Sources: NASA Goddard Institute for Space Studies, NOAA National Climatic Data Center, Met Office Hadley Centre/Climatic Research Unit, and the Japanese Meteorological Agency.

Figure 1: NASA

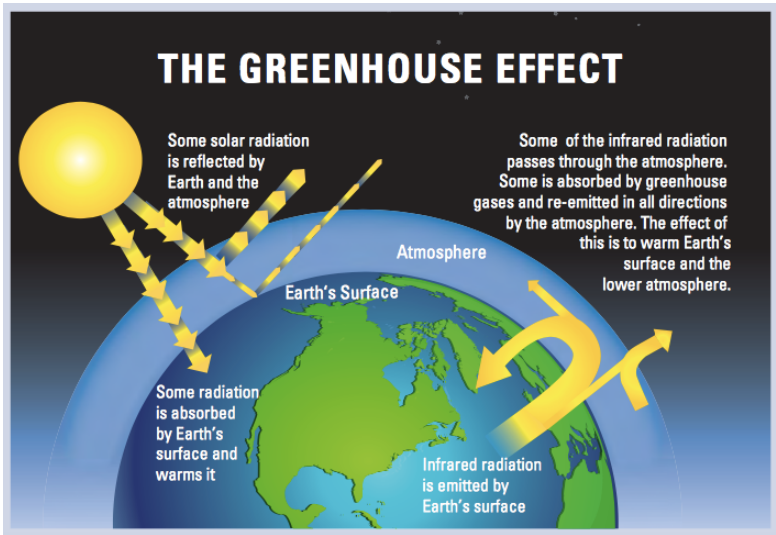


Figure 2: National Academy of Sciences

# Greenhouse Gases

- Water vapor
- *Carbon dioxide* ( $\text{CO}_2$ )
- *Methane* ( $\text{CH}_4$ )
- *Nitrous oxide* ( $\text{N}_2\text{O}$ )
- *Halocarbons*
  - Chlorofluorocarbons (CFCs)



**Total U.S. Greenhouse Gas Emissions  
by Economic Sector in 2015**

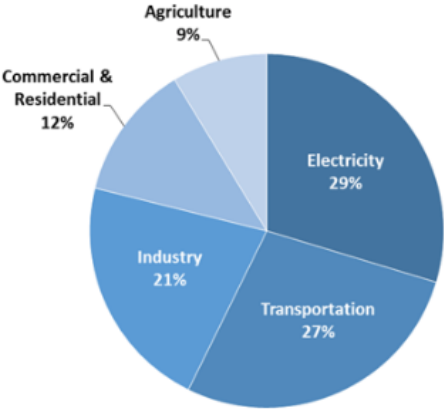


Figure 3: EPA

# Indicators of Climate Change

- Surface temperatures
- Glacier record
- Sea ice
- Sea level
- Ocean heat content
- Satellite temperature measurements
- Climate proxies
  - tree rings, ice cores, corals

# Anthropogenic

- Strong scientific consensus that human activity has increased the amount of greenhouse gases in the atmosphere
  - Burning of fossil fuels
    - Electricity
    - Transportation
  - Land use
    - Deforestation
    - Agriculture

## Anthropogenic

- Levels of carbon isotopes  $^{13}\text{C}$  and  $^{14}\text{C}$  have *decreased* in the atmosphere, while overall  $\text{CO}_2$  has increased to the highest level in 800,000 years
  - Fossil fuels have little  $^{13}\text{C}$  and no  $^{14}\text{C}$
  - Levels of  $\text{CO}_2$  in the atmosphere have passed 400 ppm, which was last seen about 3 to 5 million years ago and the Earth's temperature was about 2 to 3.5°C warmer

# Anthropogenic

- Natural causes of climate fluctuations include the Sun's output, Earth's orbit around the Sun, volcanic eruptions, and internal functions

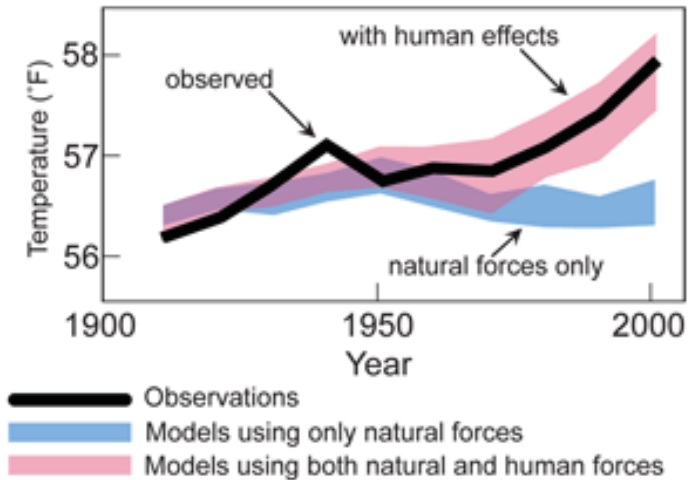


Figure 4: NOAA

# Scientific Consensus

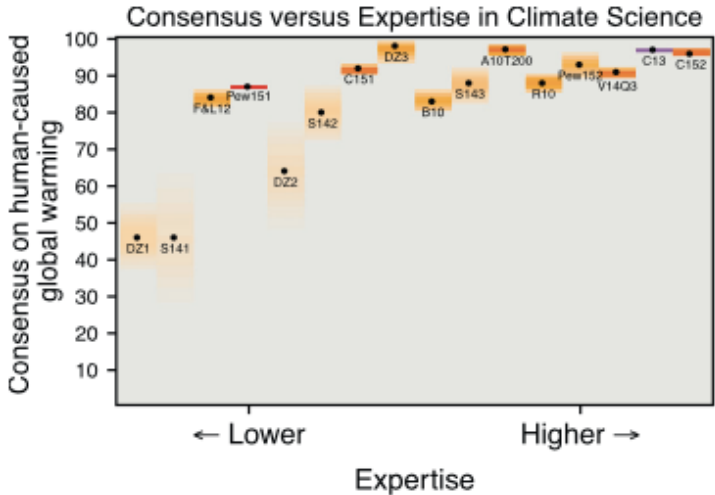


Figure 5: Cook et al., 2016

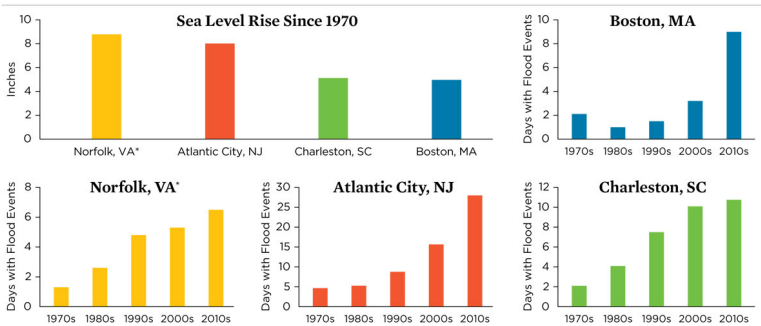
# Impacts of Climate Change

- Changes in precipitation
  - Increase in high latitudes and decrease in the subtropics
  - Greater precipitation being concentrated in heavy downpours
- Increased risk of wildfires
- Oceans are more acidic
- Sea level rise
  - Storm surge
  - Tidal (nuisance) flooding



# Sea Level Rise

## Local Sea Level Rise and Tidal Flooding, 1970–2012



Sea level has risen by about 3.5 inches globally—but more along the East Coast—since 1970. At Sewells Point, VA, for example, sea level has risen more than eight inches, and at Boston, about five inches. Rising seas mean that communities up and down the East and Gulf Coasts are seeing more days with tidal flooding. Charleston, SC, for example, faced just two to three days with tidal flooding a year in the 1970s. The city now averages 10 or more such days annually.

\*Norfolk statistics recorded at the Sewells Point tide gauge. © Union of Concerned Scientists 2014; [www.ucsusa.org/encroachingtides](http://www.ucsusa.org/encroachingtides)  
SOURCES: UCS ANALYSIS; MORALES AND ALSHEIMER 2014; NOAA TIDES AND CURRENTS 2014; NOAA TIDES AND CURRENTS 2013B.

Figure 6: UCS

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What is  
Climate  
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Addressing  
Climate  
Change

# Addressing Climate Change

# Two Types of Approaches

- Mitigation
  - Try to reduce the amount of greenhouse gases that are placed in the atmosphere
  - Policies: mandatory reductions, cap-and-trade, carbon tax
  - Technology: renewable energy, geoengineering, carbon capture
- Adaptation
  - Adjusting to the impacts of climate change
  - State and local level
  - Infrastructure, inland retreat

## Global Approaches

- Climate change is a *global* problem
- Two biggest controversies in global negotiations:
  - Binding reductions
  - Developing countries, BRICS (Brazil, Russia, India, China, and South Africa)
- *Intergovernmental Panel on Climate Change (IPCC)*
- *UN Framework Convention on Climate Change (UNFCCC)*
  - *Kyoto Protocol*
  - *Paris Accords*

# Intergovernmental Panel on Climate Change (IPCC)

- Established in 1988 by the World Meteorological Organization and UN Environment Programme
- Released five assessment reports: 1990, 1995, 2001, 2007, 2014, *sixth (2022)*

# UN Framework Convention on Climate Change (UNFCCC)

- Adopted in 1992 and ratified in 1994 (197 countries)
- A framework for how further agreements / protocols should be negotiated
- Conference of the Parties meets annually
- *“stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system”*

# Kyoto Protocol

- Adopted in 1997 and entered into force in 2005
  - International *treaty*
- 192 countries, not including the United States or Canada (withdrew in 2012)
  - US never ratified and withdrew in 2001
- In 2012, 37 countries agreed to *legally binding* reductions of greenhouse gases
  - Including the *European Union*

## Paris Accord

- Two biggest controversies in global negotiations:
  - Binding reductions
  - Developing countries, BRICS (Brazil, Russia, India, China, and South Africa)
- *Nationally Determined Contributions*
- Assistance for emerging economies
  - *Green Climate Fund*, which was negotiated in Copenhagen in 2009
- Adopted in 2015 by 195 countries, went into force on November 4th, 2016
  - Agreed to a target of 2°C, with a goal of 1.5°C
- Trump withdrawal?



## Federal Government

- American Clean Energy and Security Act of 2009
  - Cap-and-trade system for greenhouse gas emissions
  - Passed the House 219-212; filibustered in the Senate
- *Massachusetts v. Environmental Protection Agency* 2007
  - **Endangerment finding**
- *Clean Power Plan*
  - Overall emission targets for states
  - Flexible implementation

# States and Local Governments

- Renewable portfolio standards
  - Requires a percentage of electricity to come from renewable sources
  - 29 states have a *standard* and 8 states have a *goal*
- Regional Greenhouse Gas Initiative (2009)
  - Cap-and-trade program in the northeast
  - Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. New Jersey withdrew in 2012
- California
- *America's Pledge*
  - *US Climate Alliance*
  - *Climate Mayors*

# Moving Forward

- Market forces
  - Decoupling of emissions and economic growth
  - Cheaper natural gas
  - Cheaper renewable energy (solar and wind)
  - Nuclear?
- Climate change politics
  - Move beyond consensus debate
  - *Solution aversion*
- Action at multiple levels

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- Our Coastal Habitats — marsh, rivers, & beaches
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Where: Trident Technical College, North Charleston, SC

*Money provided for participation and travel.*

To learn more, visit <http://www.sceagrants.org/content/?cid=937>

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Figure 7: OCFF

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# Thank You!

- Comments and Questions
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