



Lecture 11: Introduction to Climate Change

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EGY 105 – Energy in Our World

Wilkes University



Overview of presentation



- Climate literacy
- The overall concern
- A brief history
- A question of scale
 - Global vs regional vs local
 - Climate vs weather
 - Stasis vs Fluctuation vs Change
- Global warming vs climate change
- Are atmospheric carbon dioxide concentrations increasing?
- Is our climate changing?
- Are the two linked?
 - What about natural cycles?
 - Other possible changes
- Impacts of climate change
- Can anything be done?
- Climate change predictions
- Sociology of climate change



Climate Literacy

(from <https://www.climate.gov/teaching/climate>)

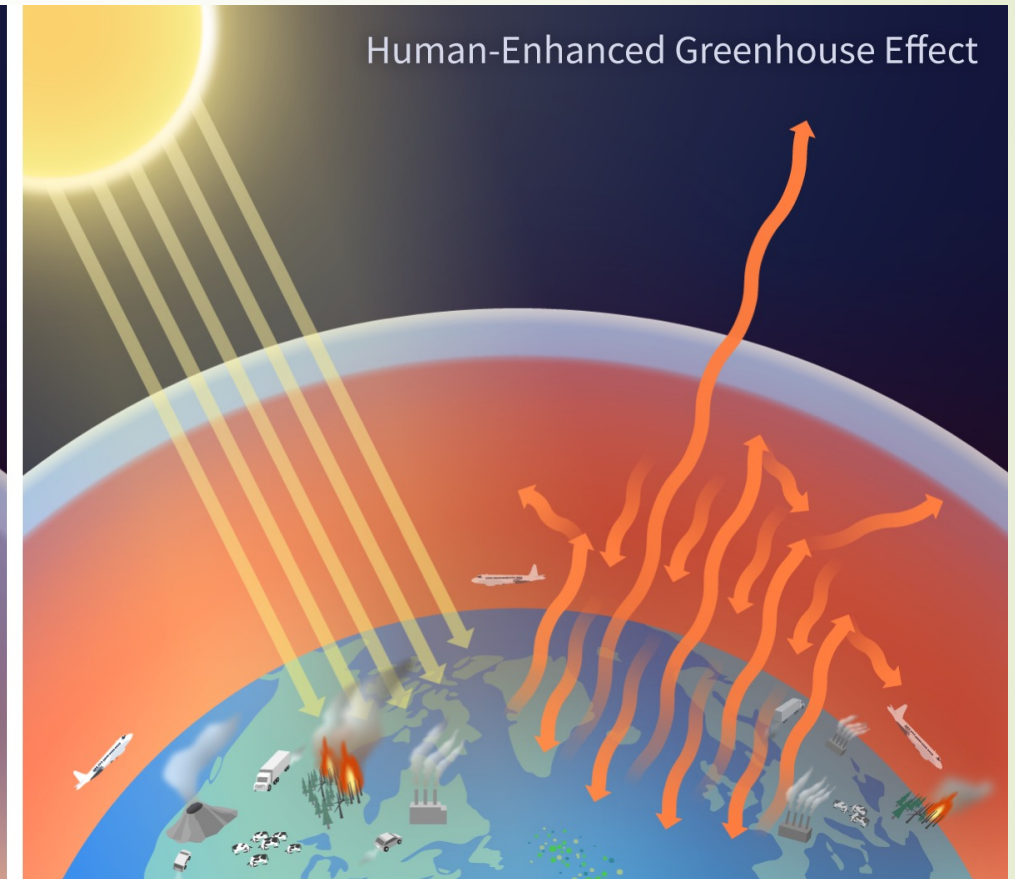
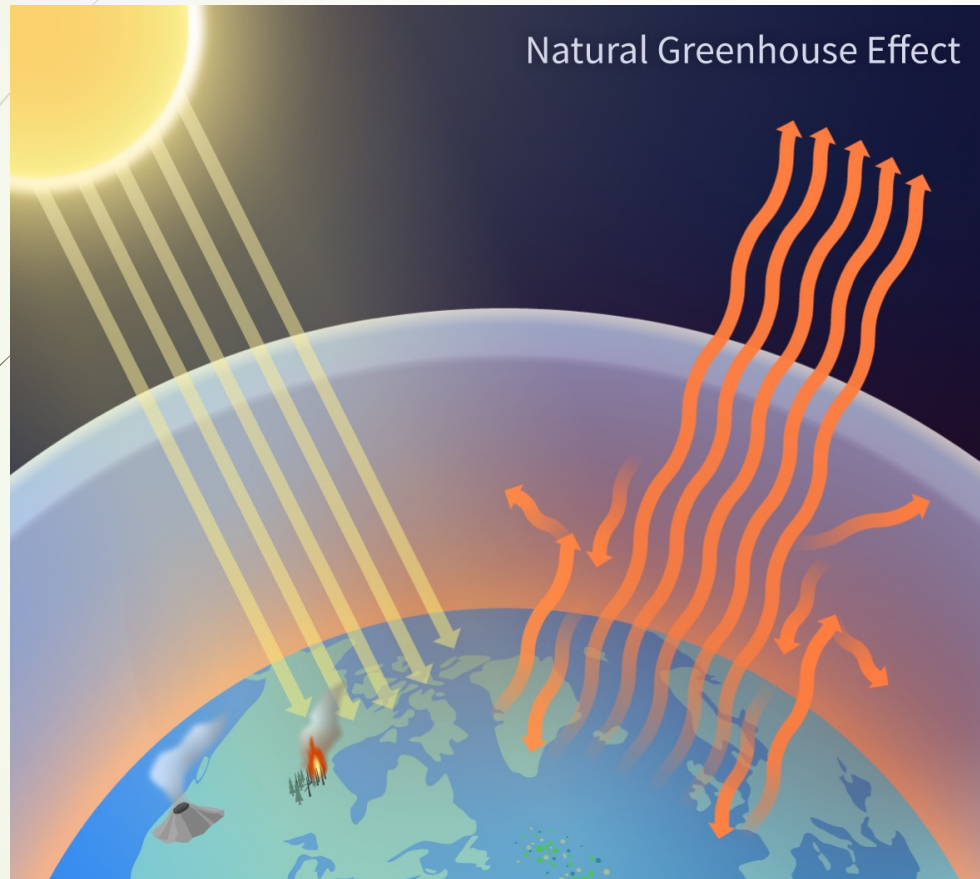
- Climate literacy is an understanding of how the climate system works, how human actions influence climate, and how climate influences people and other parts of the Earth system.
- A climate-literate person:
 - Understands the essential principles of Earth's climate system and the options to address human-caused climate change, which are summarized in this guide;
 - Recognizes credible information about climate change and knows where to find it;
 - Communicates about climate change in accurate and effective ways; and
 - Is able to make informed decisions related to climate change.



The overall concern

- Burning fossil fuels is causing the concentration of carbon dioxide in the atmosphere to increase.
- Atmospheric carbon dioxide permits solar radiation to reach the earth's surface
- When it hits the earth's surface, solar radiation is converted to infrared energy (heat)
- Carbon dioxide (and methane, nitrous oxide and water vapor) are impervious to infrared energy
- Energy is trapped at the earth's surface, raising temperatures (greenhouse effect)
- Increased carbon dioxide and temperatures will have several impacts:
 - Affect terrestrial ecosystems
 - Excess CO₂ will be absorbed by the ocean, causing it to become more acidic
 - Higher temperatures will cause polar ice caps and glaciers to melt
 - More heat at the earth's surface will intensify storms.

The Greenhouse Effect



<https://www.climate.gov/media/16408>



History of the climate change concept I

<https://www.britannica.com/story/timeline-of-climate-change>

- 1896 – Svante Arrhenius constructs first climate model of the influence of atmospheric CO₂
- 1930s- Milutin Milankovich publishes “Mathematical Climatology and the Astronomical Theory of Climatic Changes” to explain causes of Earth’s ice ages.
- 1957 – Roger Revelle and Hans Suess write that “human beings are now carrying out a large scale geophysical experiment” in a paper examining CO₂ uptake in the oceans.
- 1958 - American climate scientist Charles Keeling begins to track atmospheric CO₂ concentrations.
- 1977 – National Academies of Science release report linking rising atmospheric CO₂ to climatic changes (see <http://www.nap.edu/catalog/12024.html>).
- 1990 – First Intergovernmental Panel on Climate Change (IPCC) report notes pattern of past warming, while signaling that future warming is likely.



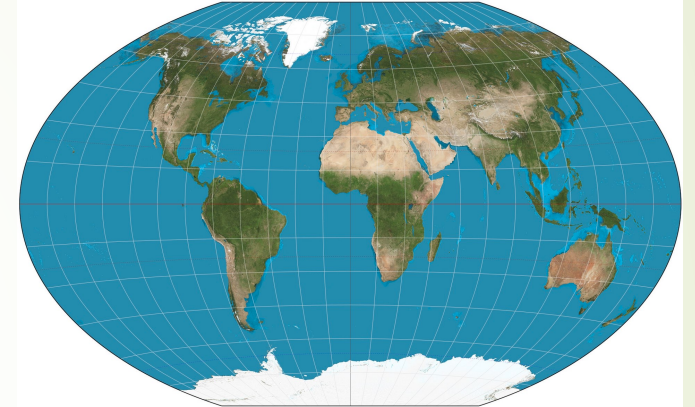
History of the climate change concept II

<https://www.britannica.com/story/timeline-of-climate-change>

- 1992 – United Nations conference in Rio de Janeiro creates the UN Framework Convention on Climate Change.
- 1997 - Kyoto Protocol is created with the intent to limit greenhouse gas (GHG) emissions from industrialized countries. The US does not sign on.
- 2001 – Third IPCC report notes that warming resulting from GHG emissions has become very likely.
- 2005 – Kyoto Protocol goes into effect. All major industrialized countries but the U.S. sign on.
- 2007 – Fourth IPCC report notes that effects of global warming are occurring.
- 2015 – Paris Agreement (which replaces Kyoto Protocol) is adopted by nearly 200 countries, including the U.S.
- 2017 – United States withdraws from the Paris Agreement.
- 2021 – Sixth IPCC report notes unequivocally that human activity has brought widespread and rapid changes to the atmosphere, hydrosphere and biosphere.

Global vs regional vs local

- Global refers to conditions around the world.
 - Continents and oceans
 - Northern and southern hemispheres
 - Equatorial and mid-latitude and polar
- Regional refers to conditions over an area measuring hundreds of square miles.
 - Size of a state or small country
- Local refers to conditions over an area measuring less than one to a dozen (or so) square miles.
 - Your backyard
 - The Wilkes campus
 - The city of Wilkes-Barre
 - Luzerne County



By Strebe - Own work, Public Domain,
<https://commons.wikimedia.org/w/index.php?curid=16115375>



<http://www.wilkes.edu>

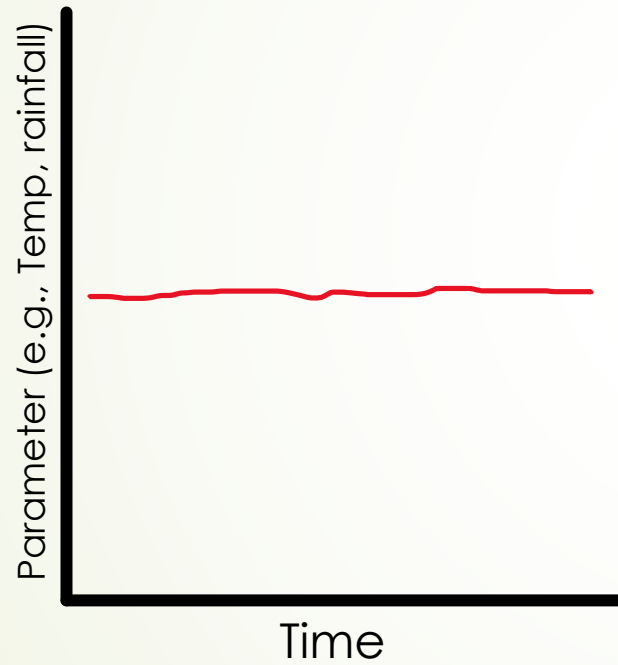


Climate vs Weather

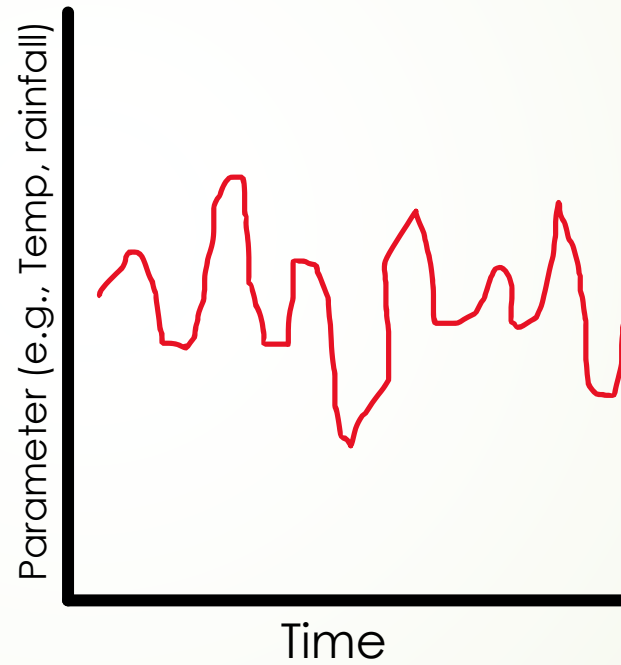
(From <https://www.epa.gov/climatechange-science/frequently-asked-questions-about-climate-change#global-warming-climate-change>)

- "Weather" refers to the day-to-day state of the atmosphere such as the combination of temperature, humidity, rainfall, wind, and other factors.
 - "Climate" describes the weather of a place averaged over a period of time, often 30 years.
 - Climate is something that can be expected to happen in general, like a cold winter season, whereas weather is what a person might experience on any given day, like a snowstorm in January or a sunny day in July.
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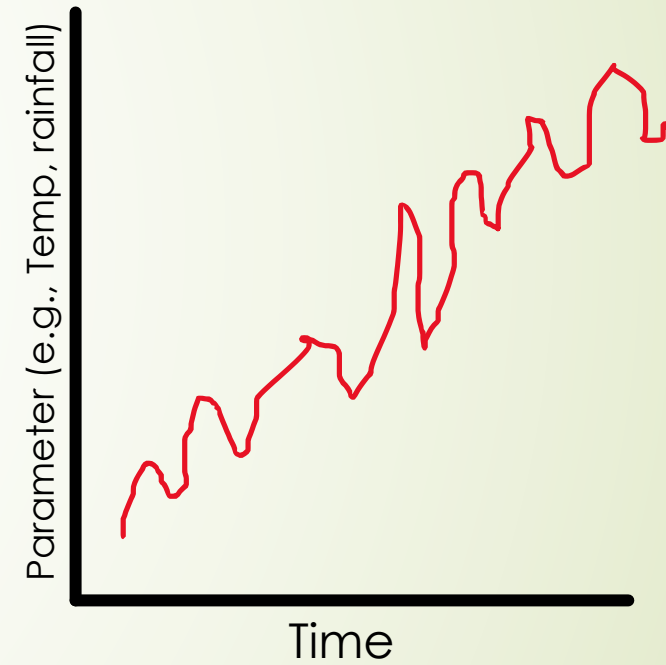
Stasis



Fluctuation



Change





What is Climate Change?

(From <https://www.epa.gov/climatechange-science/frequently-asked-questions-about-climate-change#global-warming-climate-change>)

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- Climate change involves significant changes in average conditions—such as temperature, precipitation, wind patterns, and other aspects of climate—that occur over years, decades, centuries, or longer.
 - Climate change involves longer-term trends, such as shifts toward warmer, wetter, or drier conditions.
 - These trends can be caused by natural variability in climate over time, as well as human activities that add greenhouse gases to the atmosphere like burning fossil fuels for energy.

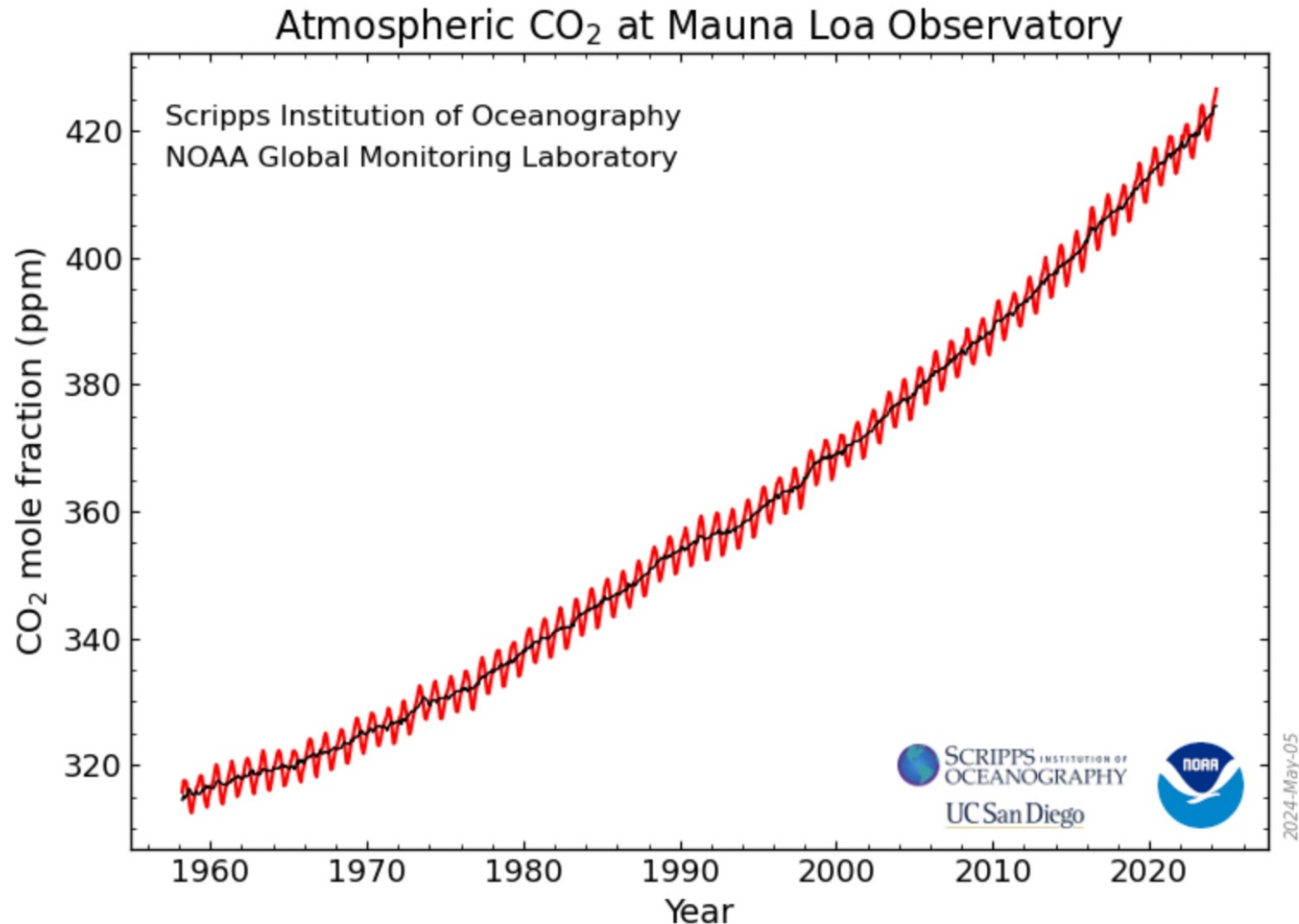


Global warming vs climate change

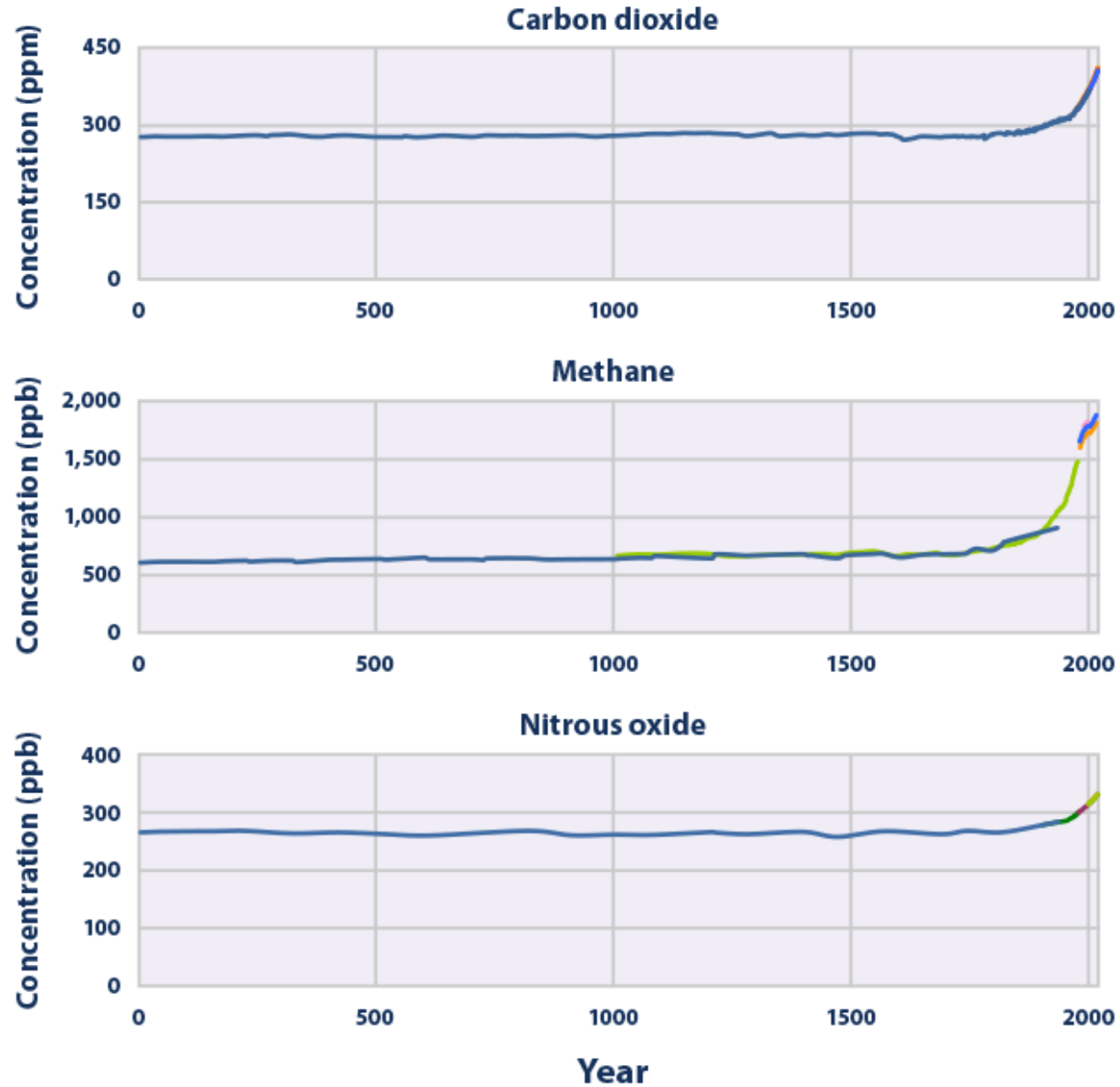
(From <https://www.epa.gov/climatechange-science/frequently-asked-questions-about-climate-change#global-warming-climate-change>)

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- The terms "global warming" and "climate change" are sometimes used interchangeably, but global warming is just one of the ways in which climate is affected by rising concentrations of greenhouse gases.
 - "Global warming" describes the recent rise in the global average temperature near the earth's surface, which is caused mostly by increasing concentrations of greenhouse gases (such as carbon dioxide and methane) in the atmosphere from human activities such as burning fossil fuels for energy.

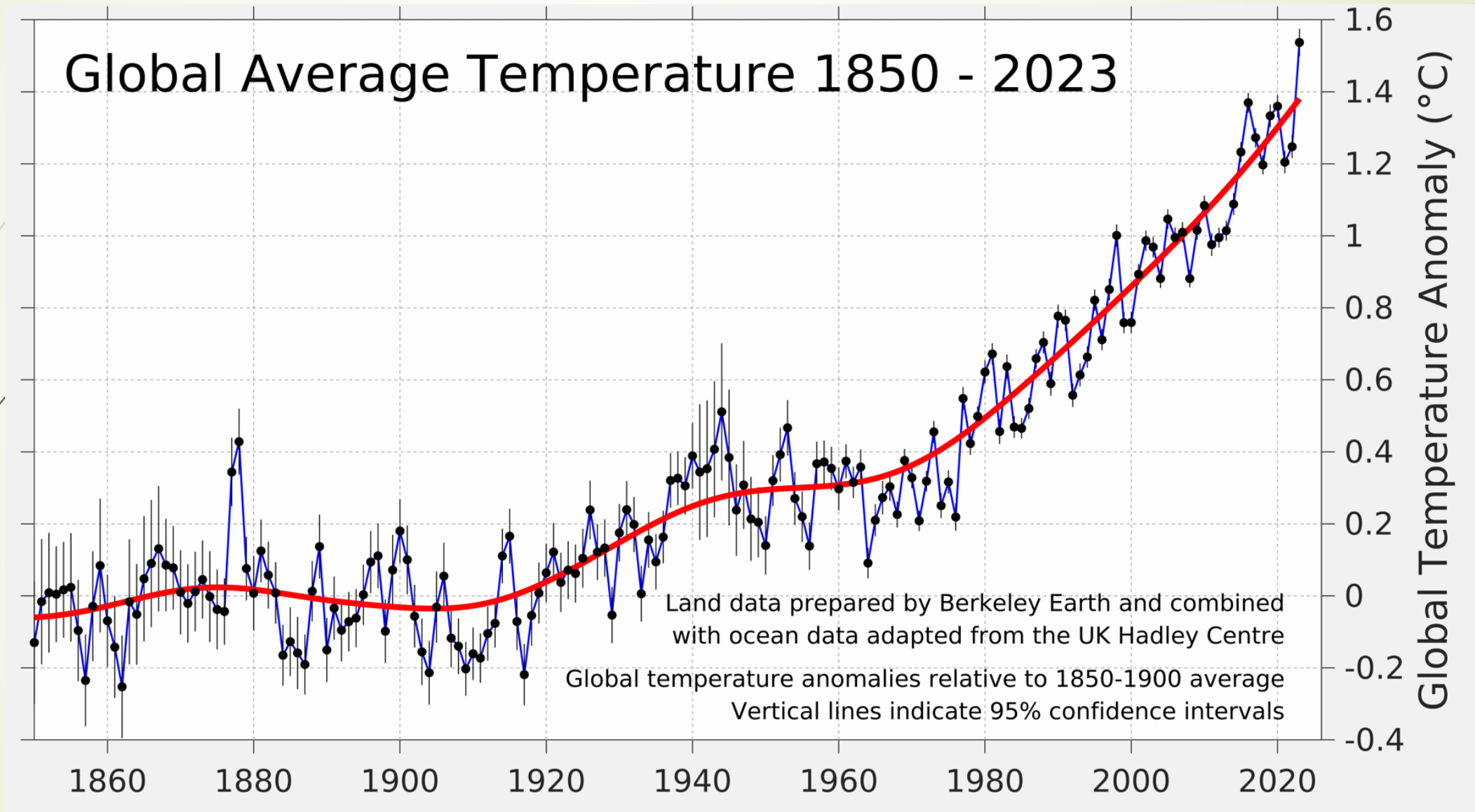
Are atmospheric carbon dioxide concentrations changing?



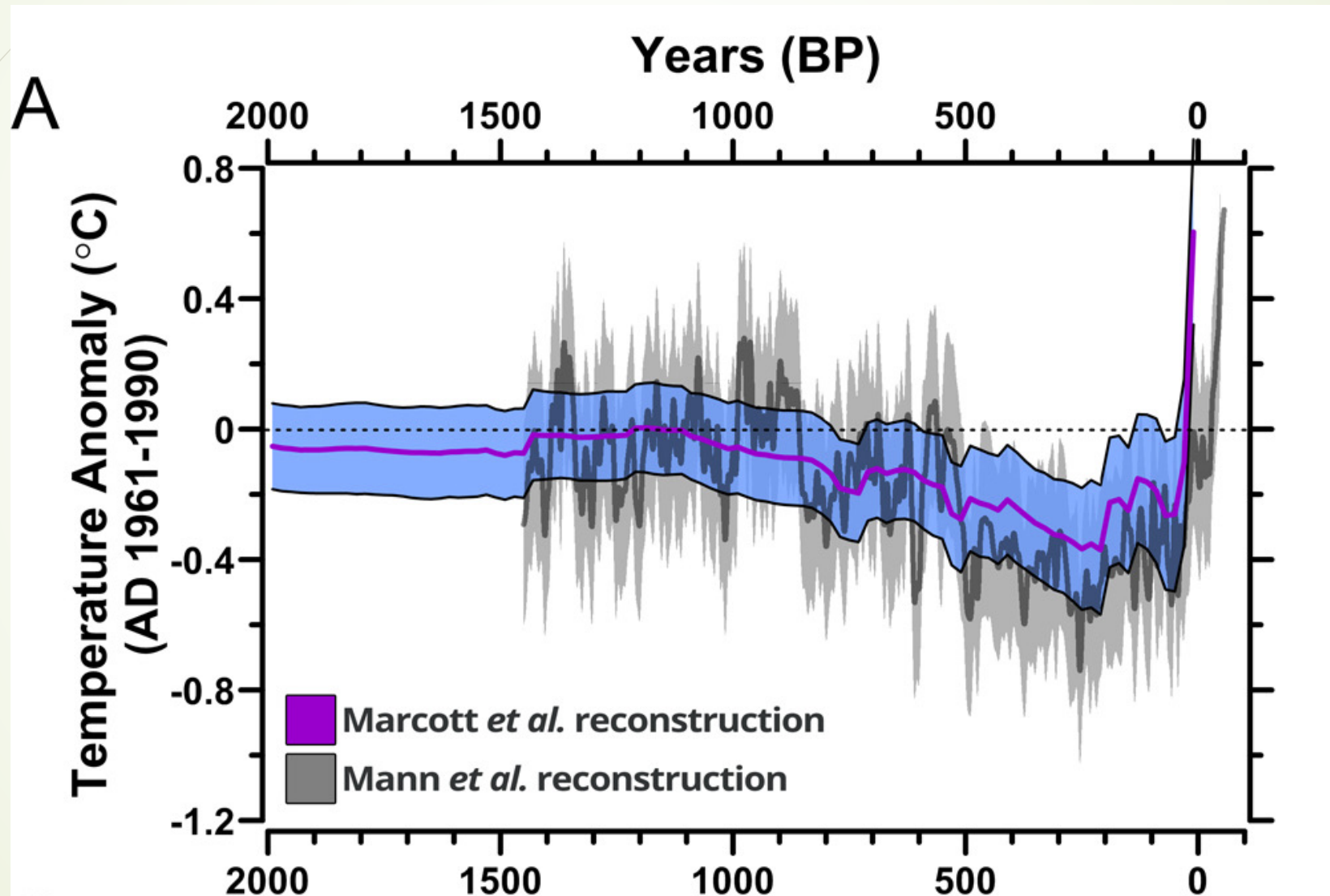
Global Atmospheric Greenhouse Gas Concentrations Over Time



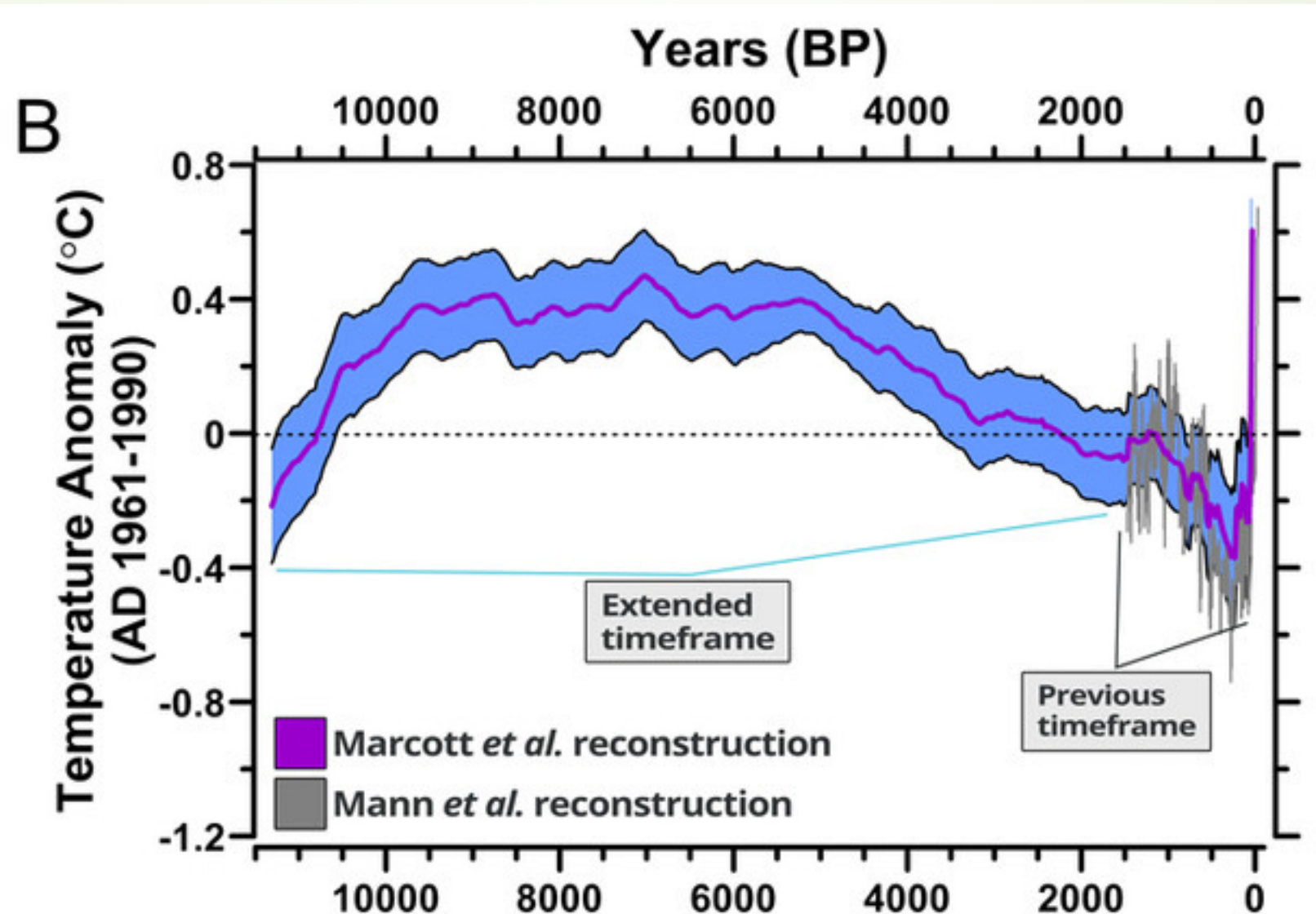
Are Global Temperatures Changing Over Time?



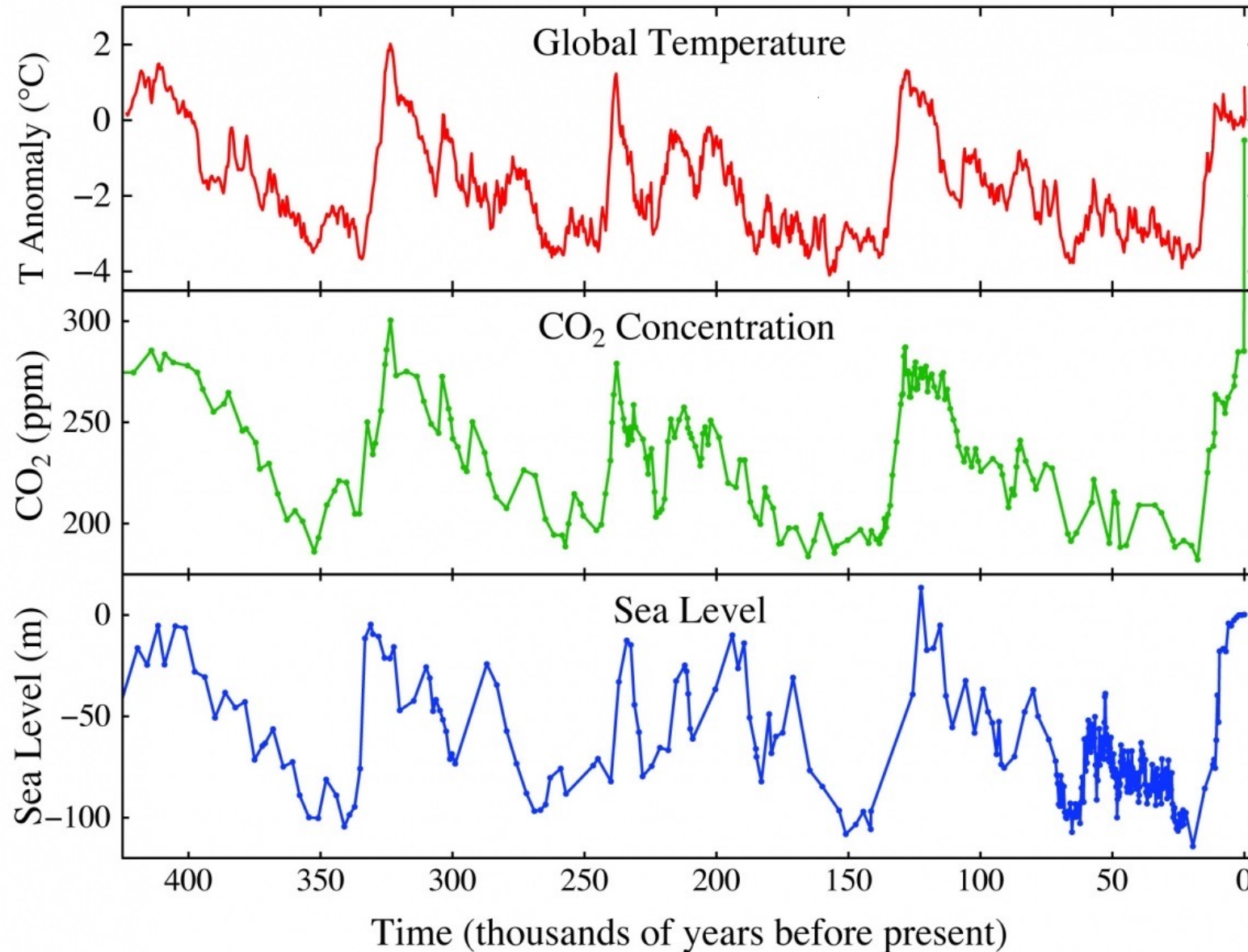
Temperature trend, last 2000 years



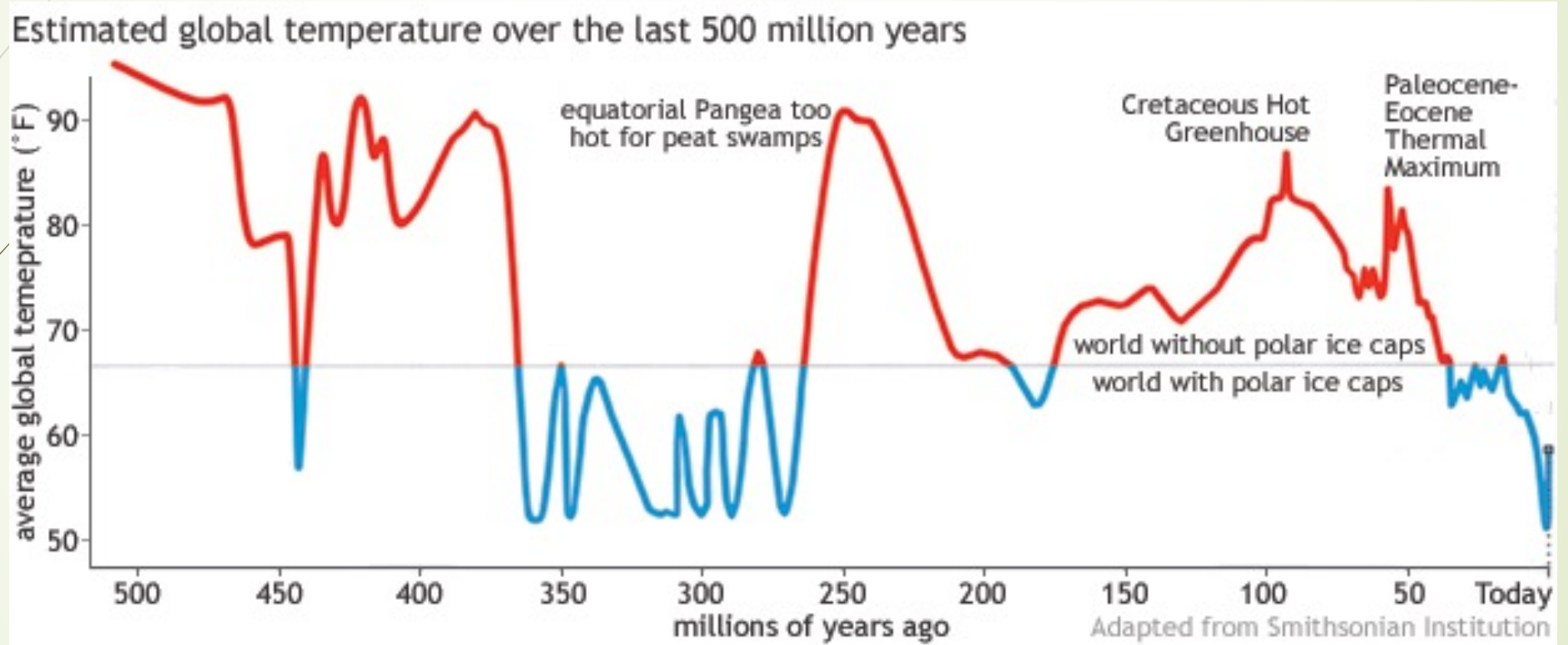
Temperature trend, last 11,000 years



Temperature trend, last 420,000 years

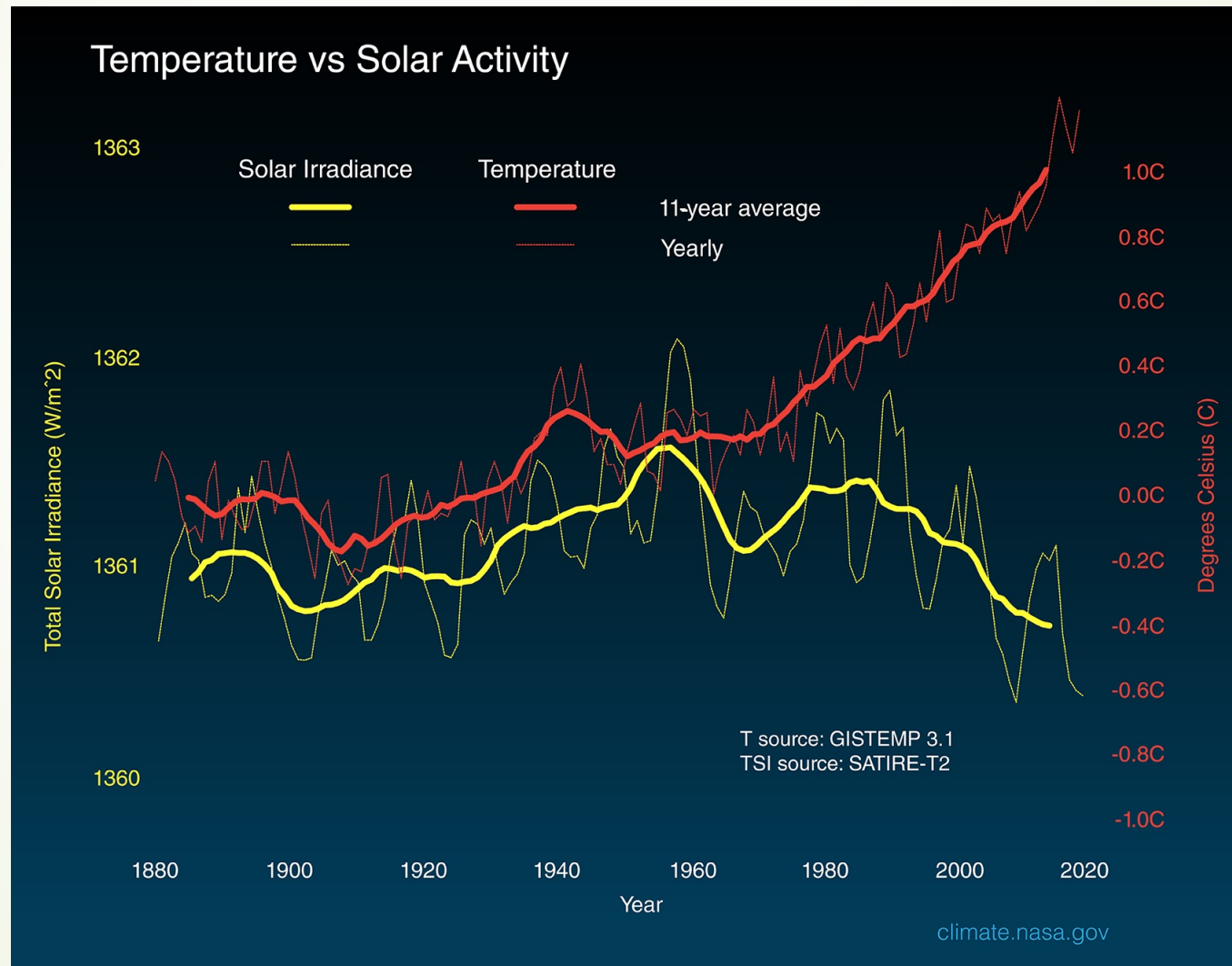


Temperature trend, 500 million years

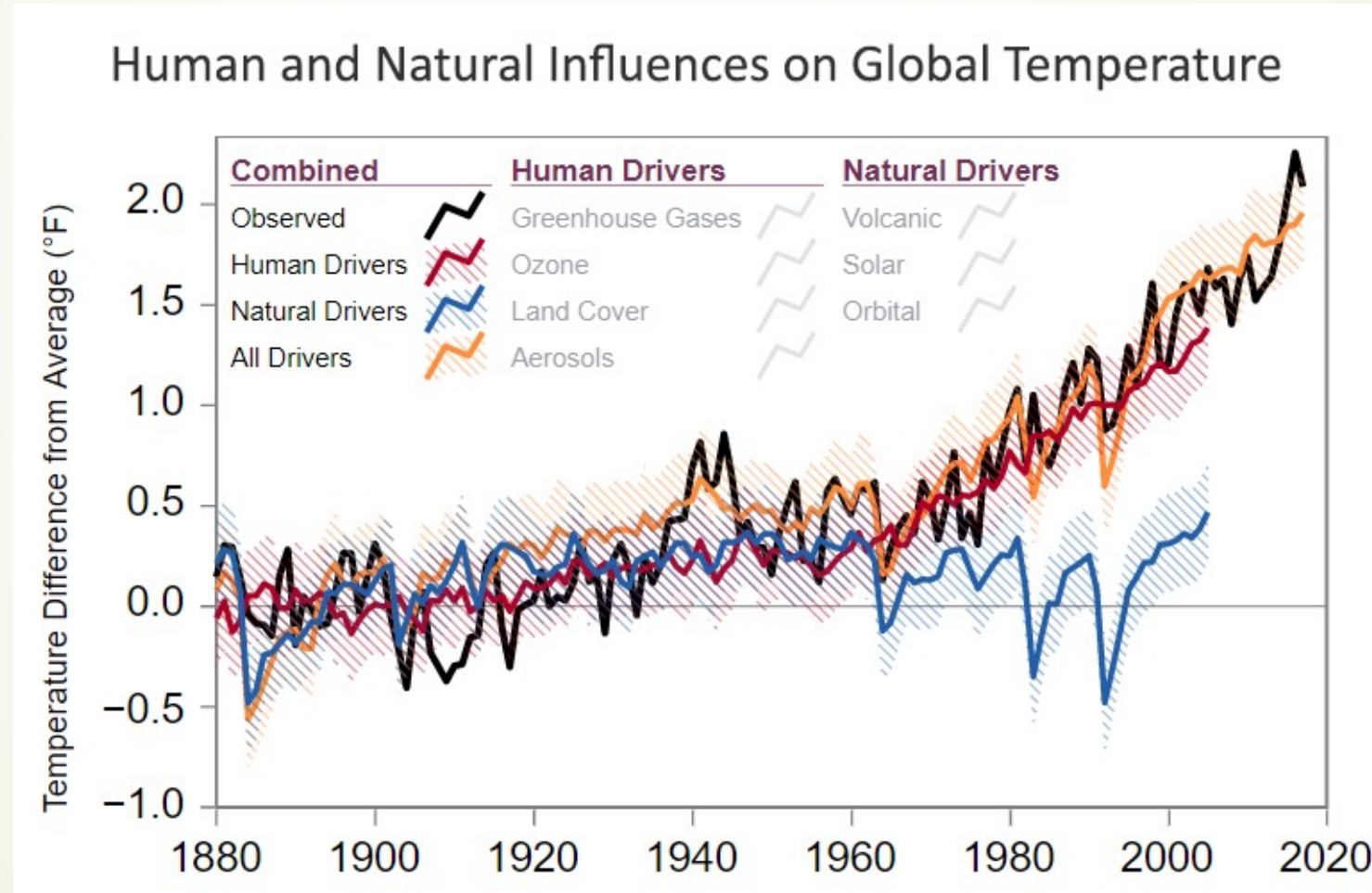


<https://www.climate.gov/news-features/climate-qa/whats-hottest-earths-ever-been>

Is climate change due to variability in solar intensity?



Look at all natural and human causes (drivers)





Impacts of climate change

Adapted from <https://www.epa.gov/climatechange-science/impacts-climate-change>

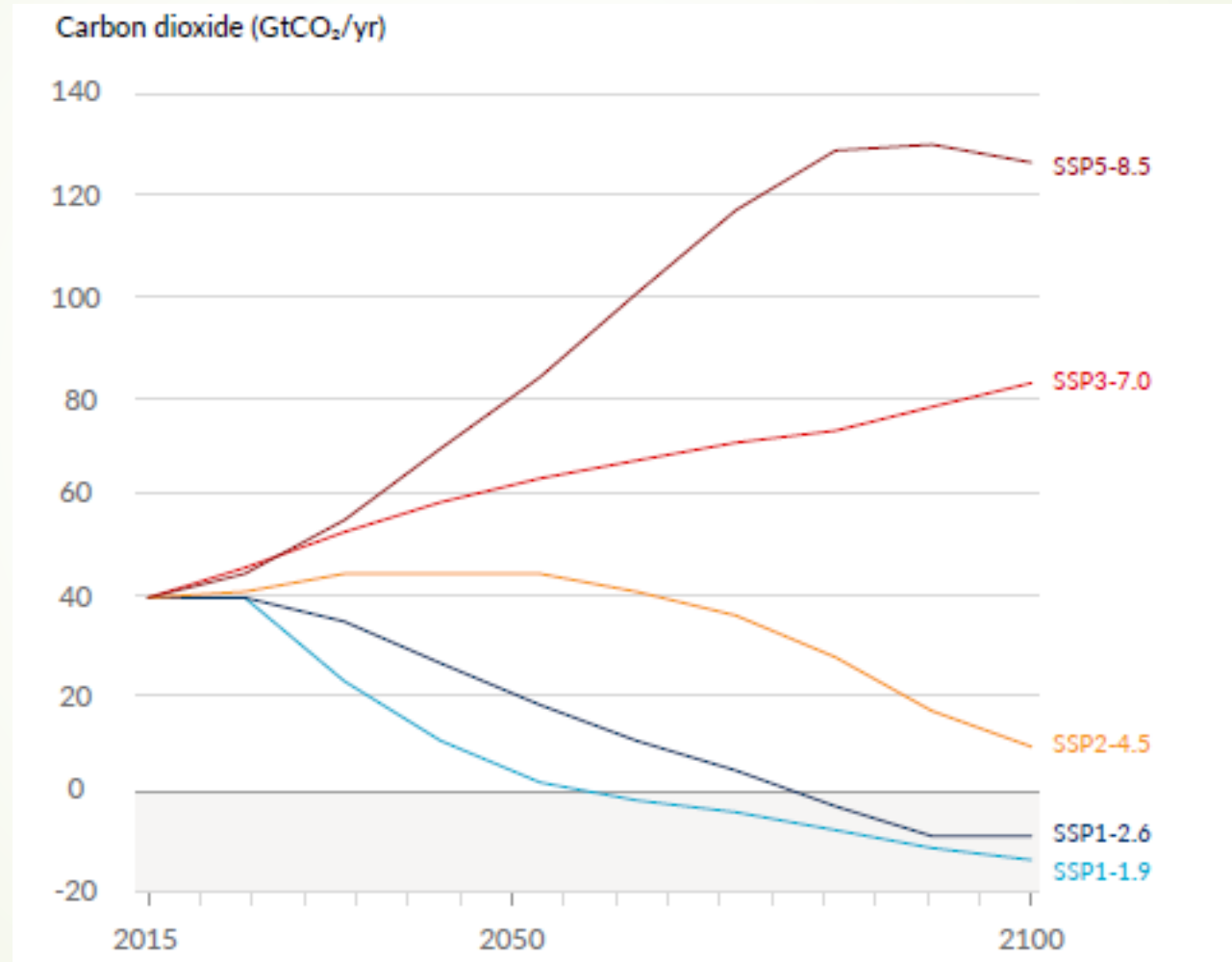
- Warmer temperatures increase the frequency, intensity, and duration of heat waves and other extreme weather events
 - leading to loss of life and property.
 - Increasing insurance costs
 - Rising sea level due to melting polar ice caps threatens coastal communities and ecosystems.
 - Changing rainfall patterns can affect water quality and availability
 - Worsening air and water quality adversely affects human health, increasing the spread of some diseases,
 - Changing climates can lead to shifts in species distribution; disrupt ecosystem interactions; evidence that some weeds benefit from warmer temperatures.
 - The interface between energy, food, and water is now heavily researched.
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What can we do?

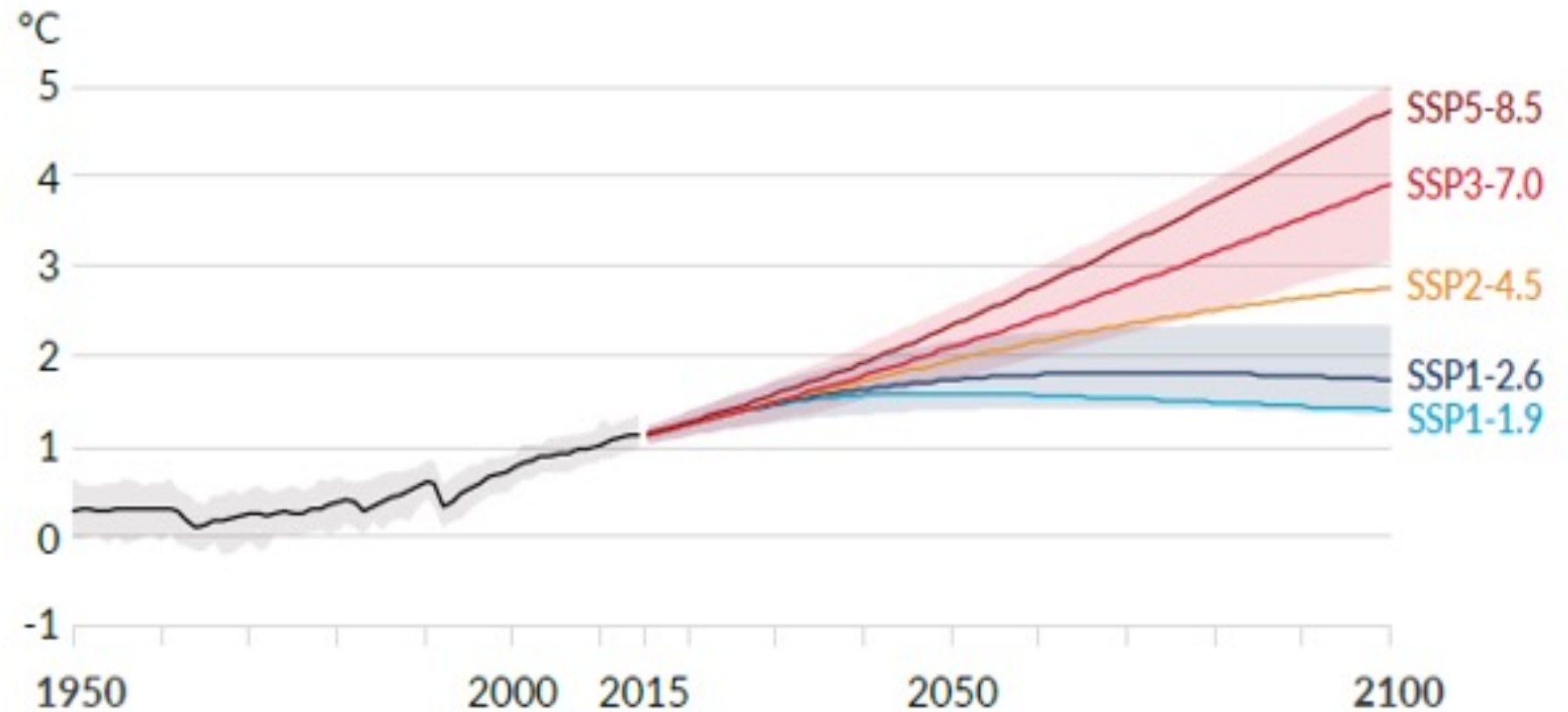
- Try to end fossil fuel use
 - Can we, and should we? (Course theme)
 - Try to adapt to change
 - See <https://www.epa.gov/arc-x/strategies-climate-change-adaptation>
 - Use technological fix
 - [Carbon capture and sequestration \(CCS\)](#)
 - [Climate geoengineering](#)
 - Deny and ignore it.
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Climate change predictions – CO₂



Climate change predictions II – Temp.

a) Global surface temperature change relative to 1850-1900





Sociology of climate change

- The vast majority of climate scientists accept anthropogenic climate change
 - Oddly, rejected by some meteorologists
 - The idea of climate change has become politicized.
 - Generally embraced by political liberals
 - Generally rejected by conservatives.
 - Allege scientists are liars and fear mongers
 - Sociologists have studied phenomenon
 - See <https://www.pbs.org/wgbh/nova/article/climate-change-acceptance/> for excellent article
 - Some students suffer from climate anxiety
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So much more to learn

- See Chapter 9 of your text!
- [US Department of Interior Internet Resources on Climate Change](#)
- [NOAA Climate.gov](#)
- [NASA Climate Change](#)
- [Intergovernmental Panel on Climate Change \(IPCC\)](#)
- [Climate.gov](#)
- [RealClimate – Climate science from climate scientists](#)
- [National Academies of Science – Climate Change](#)
- [ExxonMobil 2024 Advancing Climate Solutions Report](#)
- [Yale University Climate Change Communication](#)
- [Skeptical Science](#)