

Climate Change Indicators

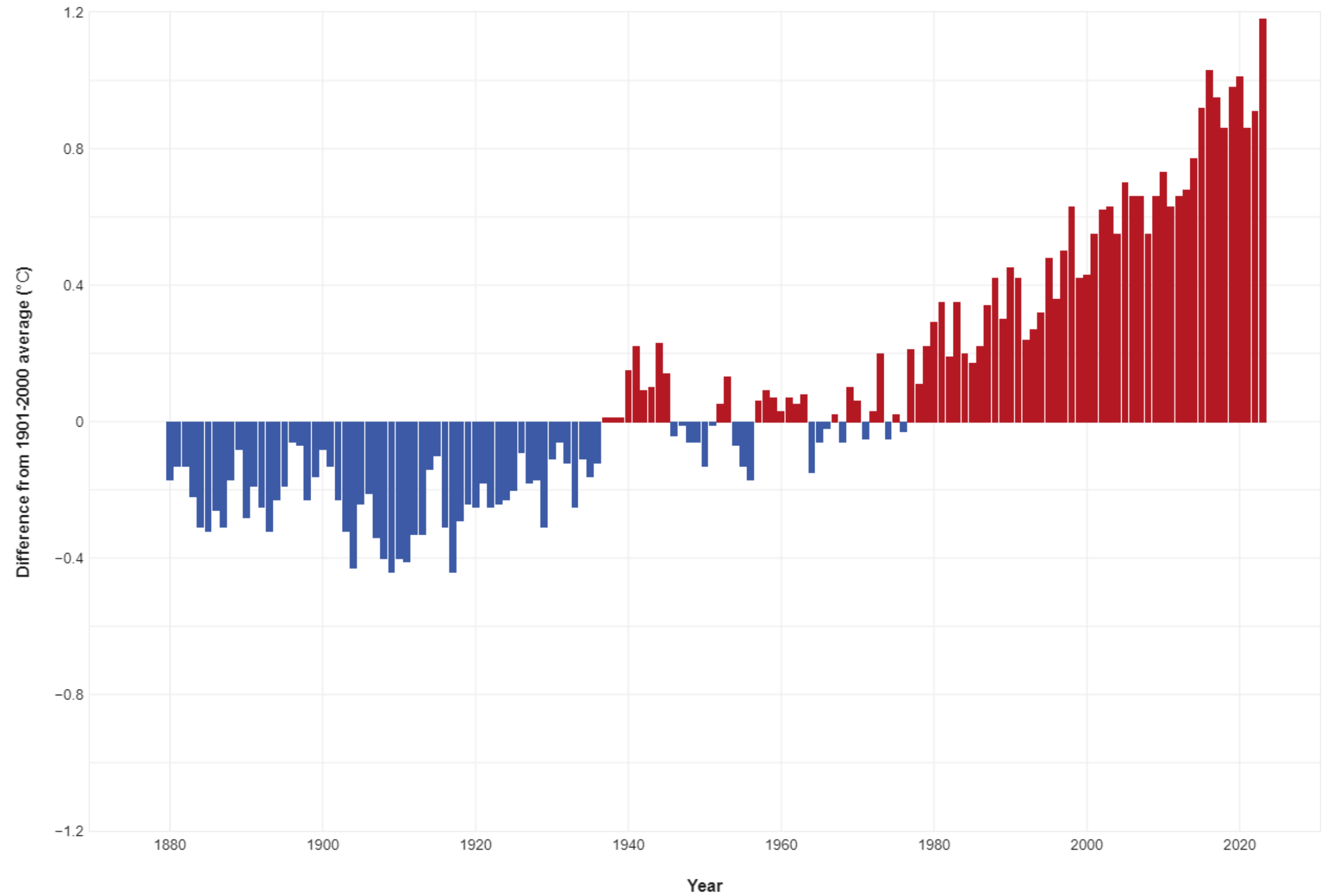
Year 10 Science



Temperature

Changes in global average surface temperature, years 1880-2020.

GLOBAL AVERAGE SURFACE TEMPERATURE

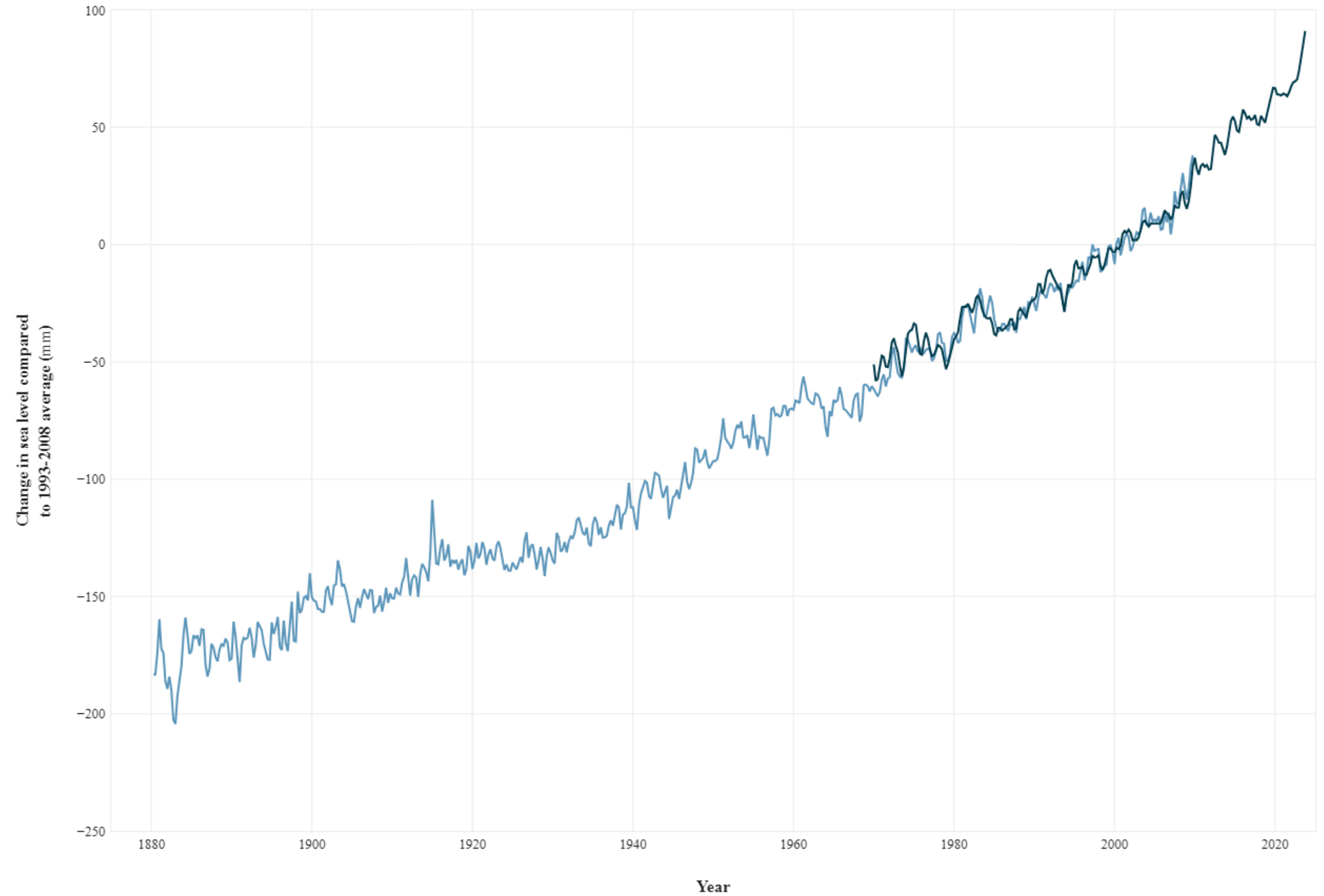


Source: climate.gov

Sea Level

Changes in global sea level, years 1880-2020.

GLOBAL SEA LEVEL

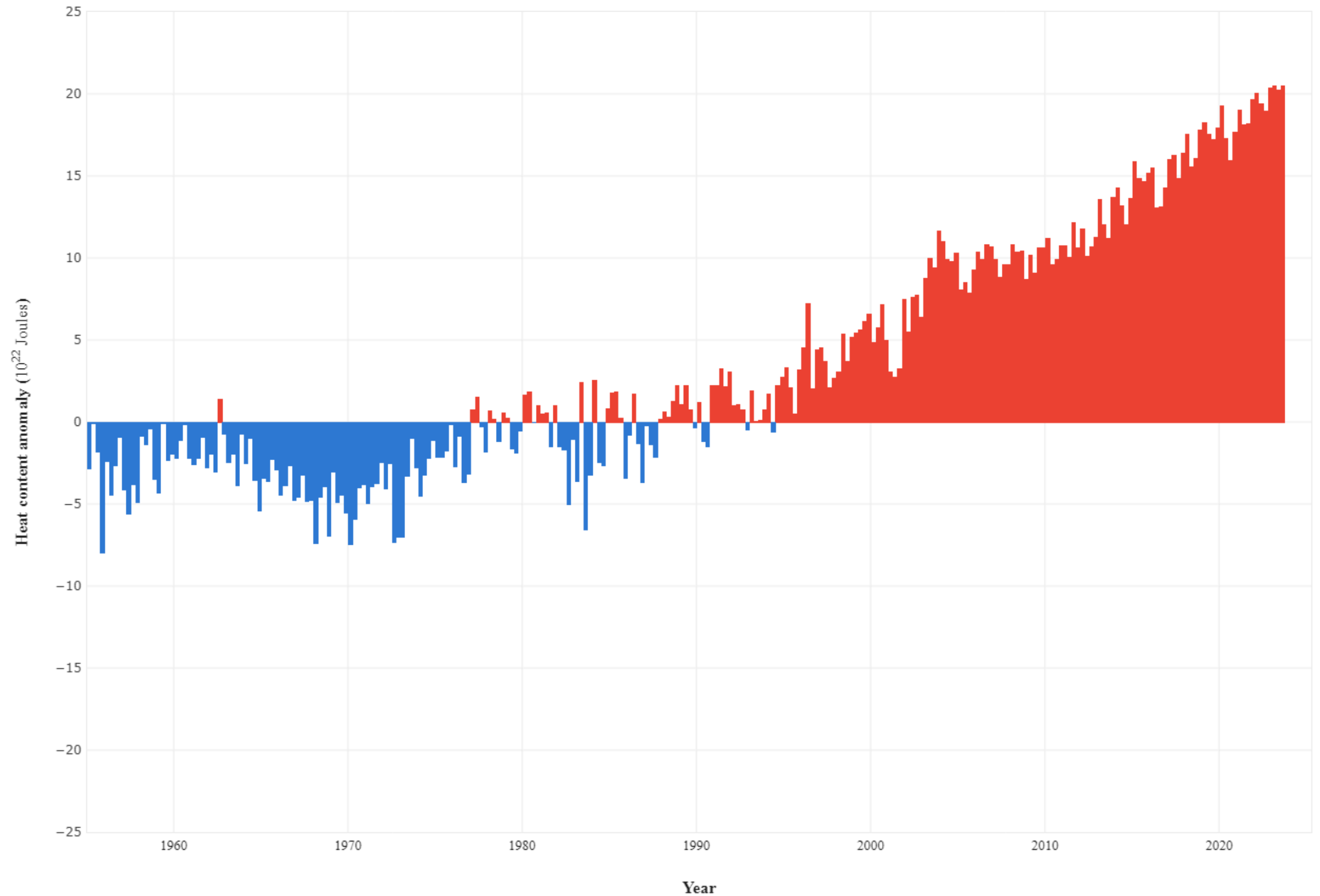


Source: climate.gov

Ocean Temperatures

Changes in ocean temperature, years 1880-2020.

OCEAN HEAT COMPARED TO AVERAGE

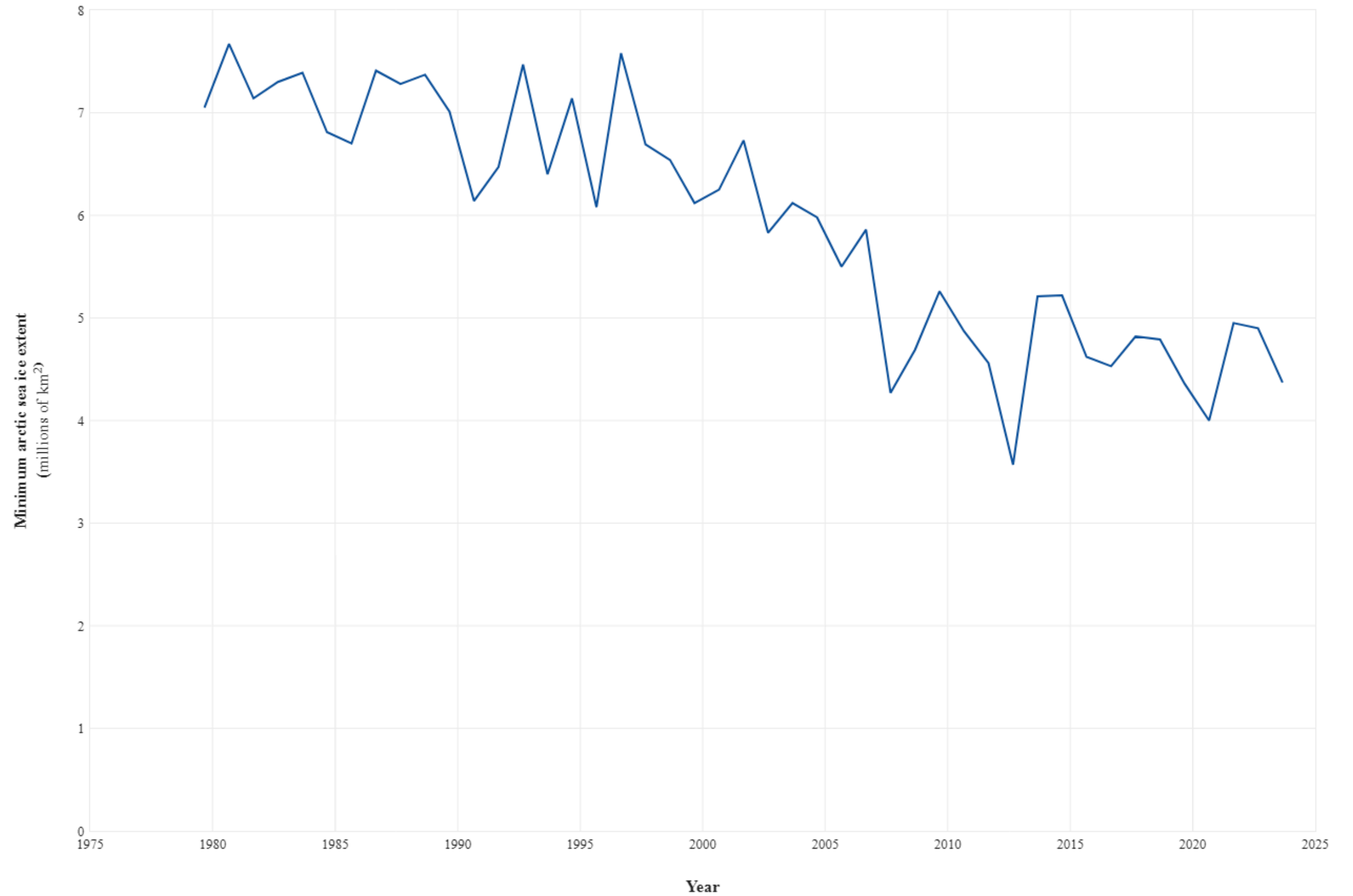


Source: climate.gov

Sea Ice Coverage

Changes in Arctic sea ice coverage, years 1980-2022.

ARCTIC SEA ICE YEARLY MINIMUM



Source: climate.gov

Ice Cores

An ice core is a long cylinder of ice drilled from glaciers or ice sheets, which scientists study to learn about past climates. As snow falls and compacts into ice over centuries, it traps air bubbles and other particles that provide a snapshot of the Earth's atmosphere at different times.

By analysing the layers of ice, which are like rings in a tree, scientists can track changes in temperature, atmospheric composition, and other environmental conditions over thousands of years, showing how the climate has changed over time.

With ice cores taken in Antarctica, we have been able to collect detailed climate information stretching back nearly 800,000 years.



Source: [British Antarctic Survey](#)

Antarctic events that changed the world

Recorded in the history books

- 44 nations engaged in Antarctic science as members of SCAR **2020**
- Environmental Protocol comes into force **1998**
- COMNAP established **1988**
- Commission for the Conservation of Antarctic Marine Living Resources **1982**
- Conservation on Antarctic Seals comes into force **1972**
- Antarctic Treaty signed **1959**
- Scientific Committee on Antarctic Research (SCAR) **1958**
- International Geophysical Year sees beginning of modern research in Antarctica **1957**
- Caroline Mikkelsen becomes first woman to set foot in Antarctica **1935**
- Amundsen and Scott reach South Pole **1911/1912**
- Borchgrevink becomes first to survive winter in Antarctica **1899**
- Bransfield, Bellingshausen and Palmer sight Antarctic continent **1820**
- William Smith first landing on South Shetland Islands **1819**
- James Watt's improvement of the steam engine leads to the industrial revolution **1765**

Recorded in Antarctic ice

- 2016** Carbon dioxide concentrations in Antarctica reach 400ppm, nearly 1.5 times greater than pre-industrial levels
- 1980** Lead begins to fall in the Antarctic following the introduction of unleaded petrol¹
- 1975** Detection of DDT used as an insecticide²
- 1970** Atmospheric methane concentration double that seen for more than 800,000 years
- 1970/1980s** Concentration of copper increased by factor of two, as a result of copper smelting, particularly in South America³
- 1950-1980** Increase in lead due to use of lead additives in automotive petroleum
- 1954** Radioactive by-products from above-ground nuclear bomb tests
- 1930** PCBs from industrial production first detected⁴
- 1915** Carbon dioxide concentration exceeds that seen at any time in last 800,000 years
- 1889** Lead pollution identified from Broken Hill, South Australia⁵
- 1870** Methane concentration exceeds that seen at any time in the last 800,000 years. CO₂ levels begin to rise sharply due to burning of fossil fuels
- 1765** Global CO₂ levels at ~280ppm
- ~1760** Carbon-13/Carbon-12 ratio in atmospheric CO₂ changes as a result of forest clearance
- 1750** Carbon dioxide concentration shows first increase due to land use change (forest to farmland)

¹ <http://dx.doi.org/10.1029/94GL00656>
² <https://www.nature.com/articles/254324a0>
³ <https://www.sciencedirect.com/science/article/pii/S1352231098002763>
⁴ <http://dx.doi.org/10.1016/j.microc.2012.05.018>
⁵ <https://dx.doi.org/10.1038/srep05848>



Image: Bernhard Bereiter/Scripps Institution of Oceanography/EMPA/University of Bern

Tree Rings

Tree rings are the concentric circles that you see when you look at a cross-section of a tree trunk. Each ring represents one year of a tree's life, with wider rings indicating years of favourable growth conditions like good weather and ample water, and narrower rings showing tougher times.

By studying these rings, scientists can understand past climate conditions and how they have changed over time, as the size and density of the rings can indicate variations in temperature and rainfall.

The oldest living tree is currently around 4,800 years old, however, fossilised wood can date back more than 380 million years.

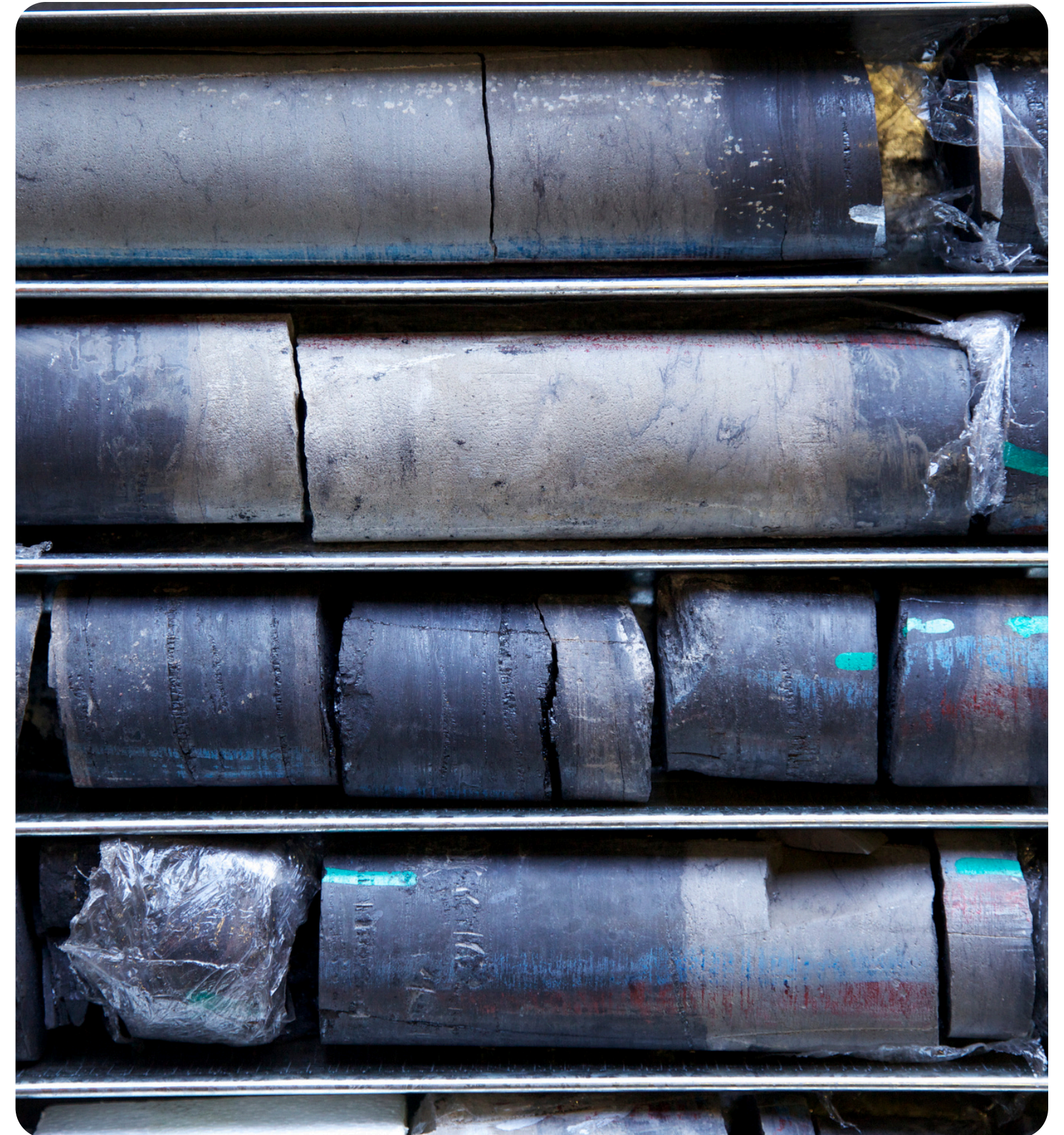


Sediment Cores

Sediment cores are long tubes of mud and sediment collected from the bottoms of oceans, lakes and rivers. As layers of sediment settle over time, they trap materials like pollen, microorganisms, and minerals that provide clues about past environmental conditions.

Scientists can reconstruct climate changes over thousands of years by examining the different layers in a sediment core, revealing how factors like temperature and sea levels have shifted over time.

These cores can provide climate records going back millions of years. The length of the record depends on the rate of sediment accumulation and the depth of the core, with some marine sediment cores capturing information from several hundred million years ago.



Coral Skeletons

Coral skeletons are the hard, protective structures that corals build using calcium carbonate, which accumulate over time as the coral grows. These skeletons contain bands similar to tree rings, and can be analysed to determine sea temperatures and other ocean conditions at different times.

By studying these bands, scientists can track changes in ocean temperatures and chemistry, providing insights into how climate change has affected marine environments over the years.

Coral skeletons can provide climate records for the lifespan of the coral colony, which can range up to several centuries. However, by studying different layers of coral growth, scientists can reconstruct climate variations over a few hundred to thousands of years, depending on the growth rate and longevity of the coral species.

