

WHAT IS THE GREENHOUSE EFFECT?

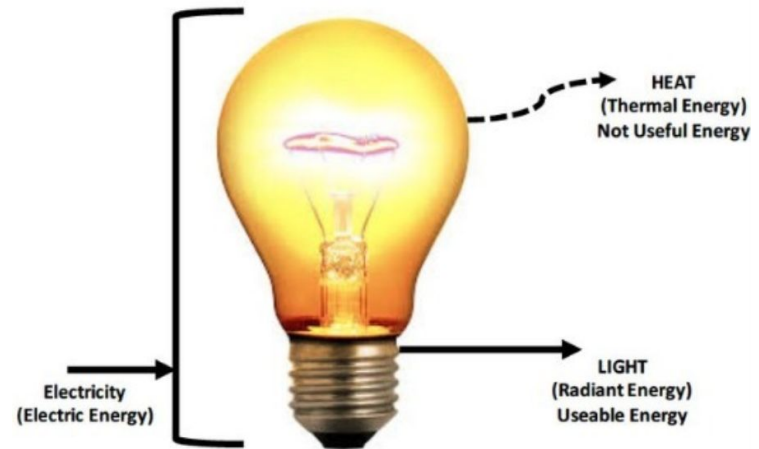
Sunlight passes through the atmosphere and warms the Earth's surface. The heat hits the Earth and then is radiated back toward space. The greenhouse gas molecules in the atmosphere absorb most of the heat and then send the heat in all directions. This warms the surface of the Earth. Some heat radiates back to space. Three Greenhouse gases are water vapor, carbon dioxide, and methane. Greenhouse gases make a thermal blanket around the Earth. More greenhouse gases mean heat is absorbed and Earth is warmer.

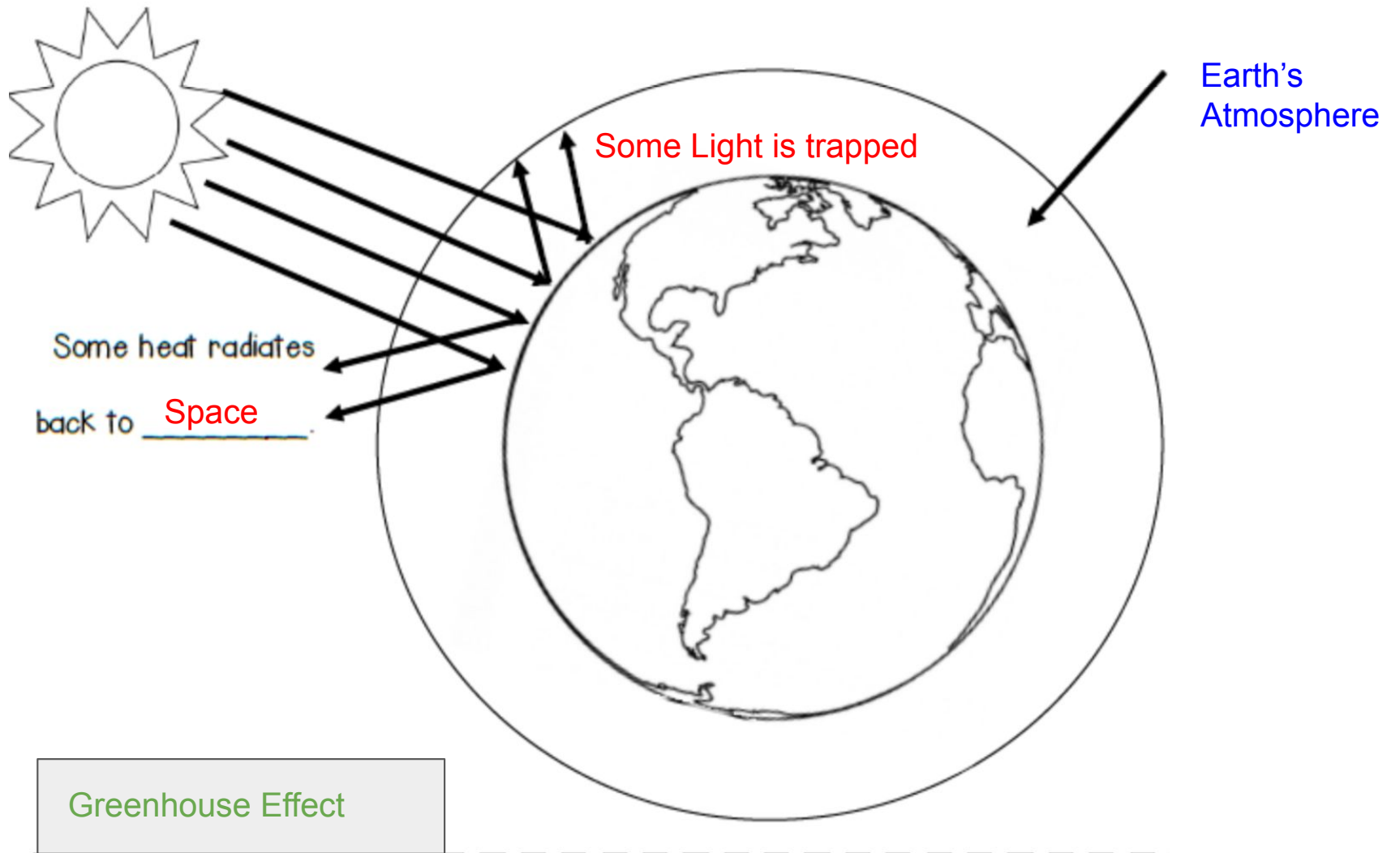
WHAT IS...

A Greenhouse Gas: Gases such as carbon dioxide and methane that absorb radiation from the sun and trap the heat in the atmosphere
Global Climate: The range of weather that varies from region to region
Global Warming: A gradual increase in temperature of the Earth's atmosphere caused by gases and pollutants.
Climate Change: A change in a region's weather conditions.
Fossil Fuel: Natural fuel formed from the remains of living organisms. Includes petroleum or oil, coal, and natural gas.



Energy Transformations





EVIDENCE OF GLOBAL CLIMATE CHANGE

Sea levels Rising & Decline of Sea Ice

Global sea levels have risen 17 cm in the last 100 years. This is double the rise in the previous 100 years. Size and thickness of the Arctic sea ice has decreased. NASA data has shown that ice sheets in Greenland and Antarctica have decreased.

Extreme Weather Events

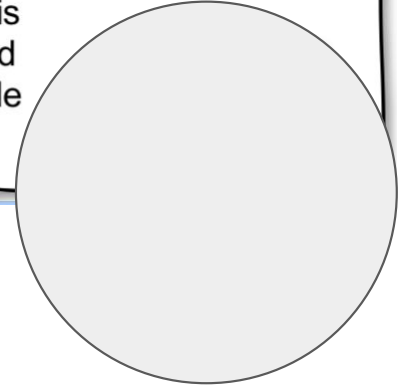
The intensity of North Atlantic hurricanes have increased in intensity and frequency. Changes in precipitation patterns- Temperatures rise and more moisture evaporates bringing more rain or snow. This is not spread evenly around the globe. Some areas may get more precipitation and some areas less.

Ocean Acidification

The acidity of the surface ocean water has increased 30% since the Industrial Revolution in the early 1800s. The ocean is absorbing more and more carbon dioxide every year.

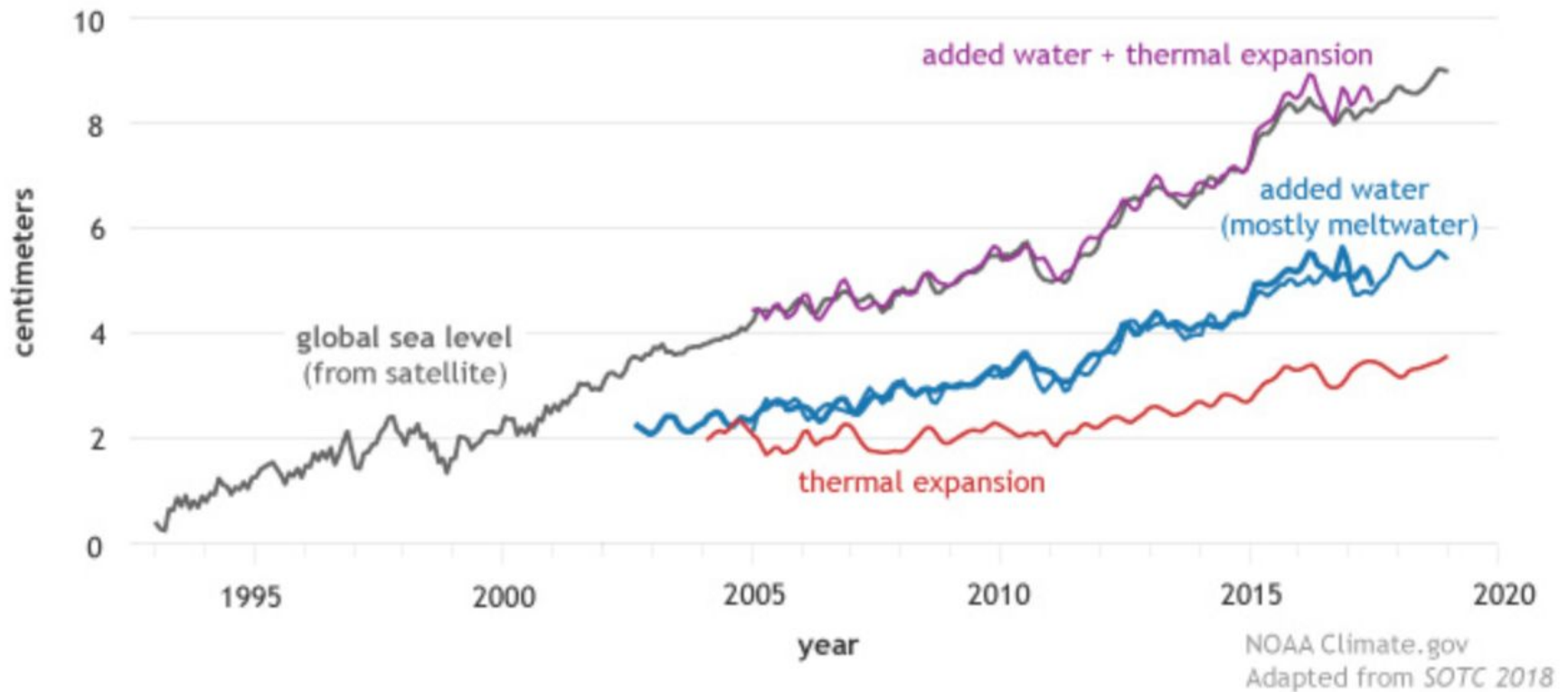
Rise of Global Temperature

The number of record high temperatures has increased.

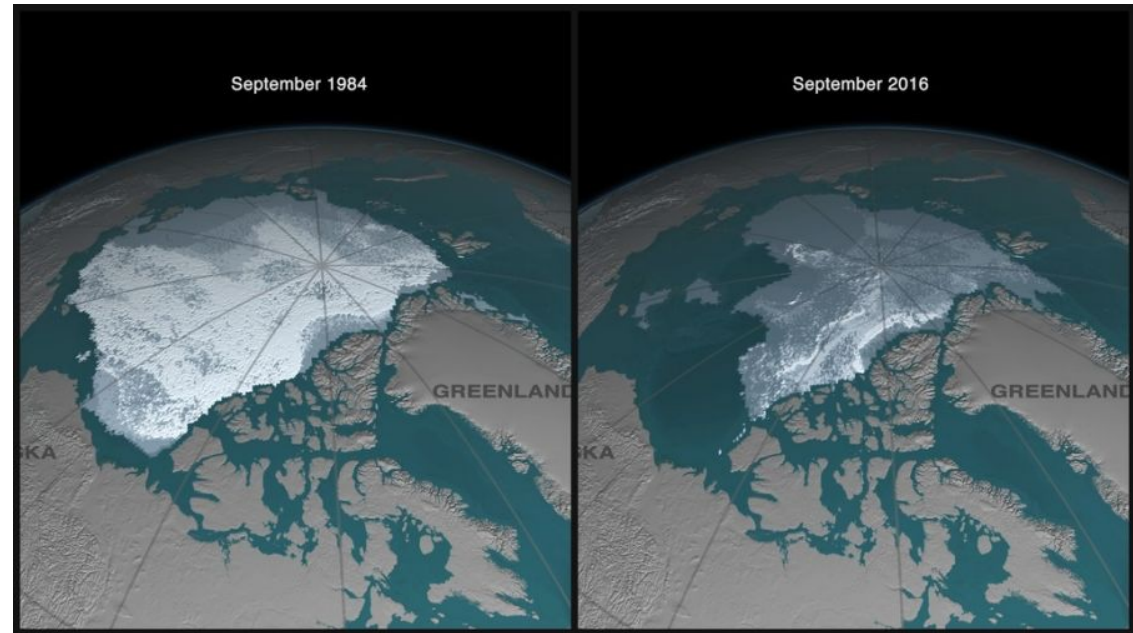


SEA LEVEL RISE and DECLINE OF SEA ICE

Contributors to global sea level rise (1993-2018)



SEA LEVEL RISE and DECLINE OF SEA ICE



Extreme Weather Events

HOW CLIMATE CHANGE AFFECTS HURRICANES

DAMAGES

Higher windspeeds from stronger storms

More rain in an area from a more moist atmosphere and stagnant weather patterns

Worsened flooding from heavier rain and more powerful storm surges due to sea level rise and higher windspeeds

TRACK

Slower storms possible from stagnant weather patterns linked to climate change

Storm location shifting likely due to changing air circulation features, but depends on ocean basin and more research needed

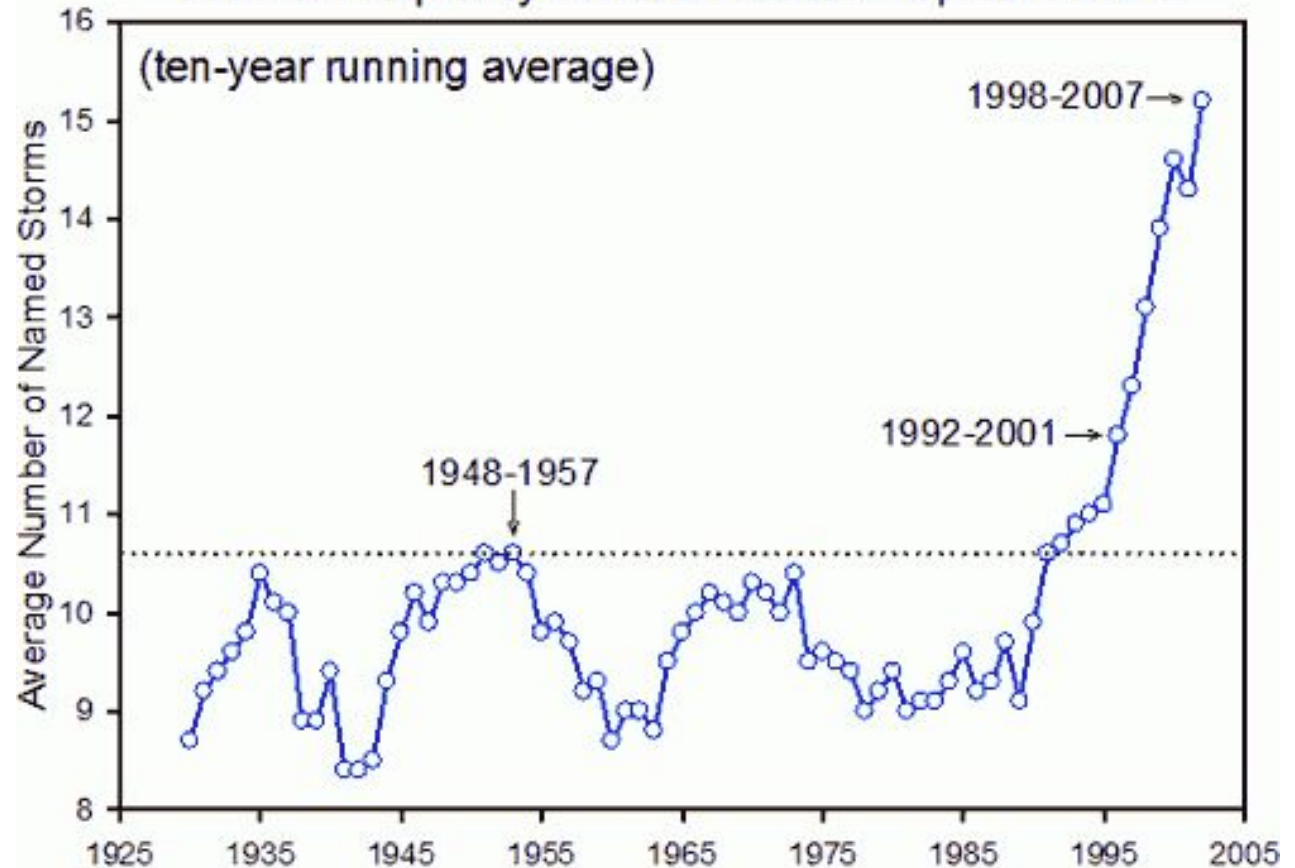
STRENGTH

Stronger and rapidly intensifying storms from warmer waters and a more moist atmosphere that provide energy for the storm

FORMATION

Unclear because while warmer waters can favor storm formation, changing circulation dynamics can make it more difficult for a storm to develop into a hurricane

Annual Frequency of North Atlantic Tropical Storms

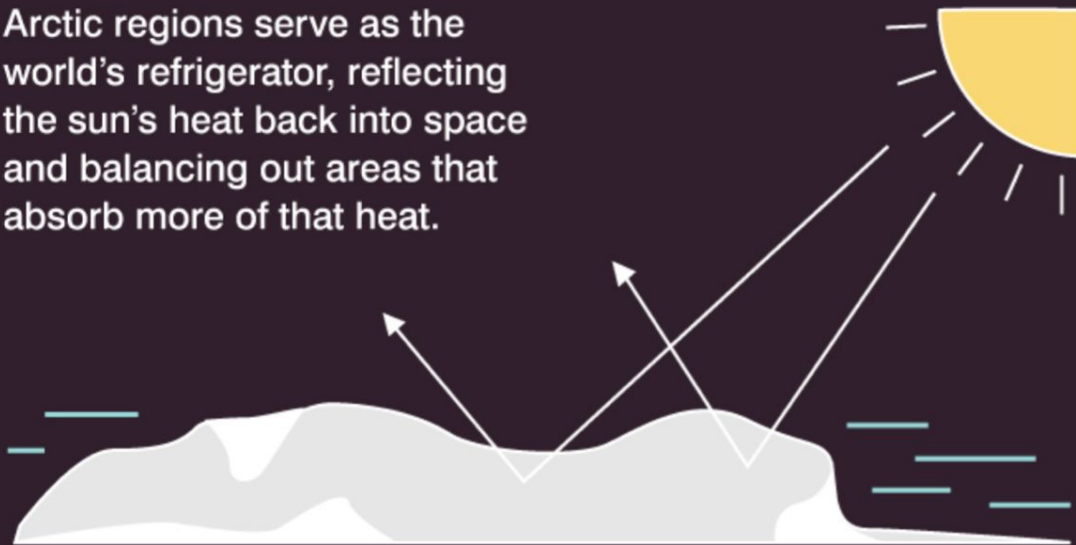


EFFECTS OF CLIMATE CHANGE



Ice-Free Arctic Regions

Arctic regions serve as the world's refrigerator, reflecting the sun's heat back into space and balancing out areas that absorb more of that heat.



The world's arctic regions lose 13% of their sea ice per decade and will be ice-free before 2050.



Source: World Wildlife Foundation

EFFECTS OF CLIMATE CHANGE



More Droughts + Heat Waves



While many areas see greater precipitation because of climate change, long-term warming of the earth is linked to more evaporation in drier parts of the world. Droughts and heat waves wreak havoc on agricultural systems and, in some cases, cause deadly famines.

Source: Natural Resources Defense Council, Inc.



In 2015, scientists said that an ongoing drought in California—the state’s worst water shortage in 1,200 years—was intensified by up to **20 percent** by global warming.

EFFECTS OF CLIMATE CHANGE

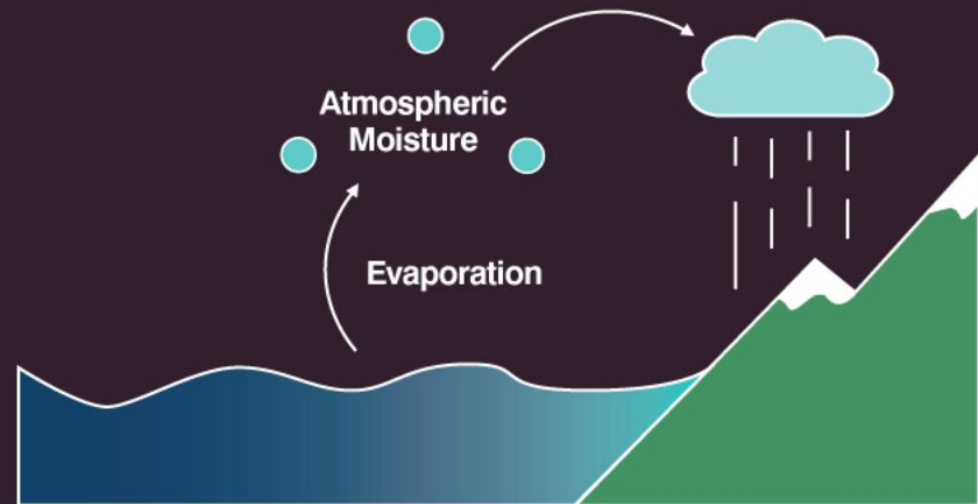


Greater Precipitation + Stronger Storms

Long-term warming increases atmospheric moisture available to storms, leading to heavier rainfall and snowfall events.



90% of the Earth's warming over the last 60 years has occurred in oceans.



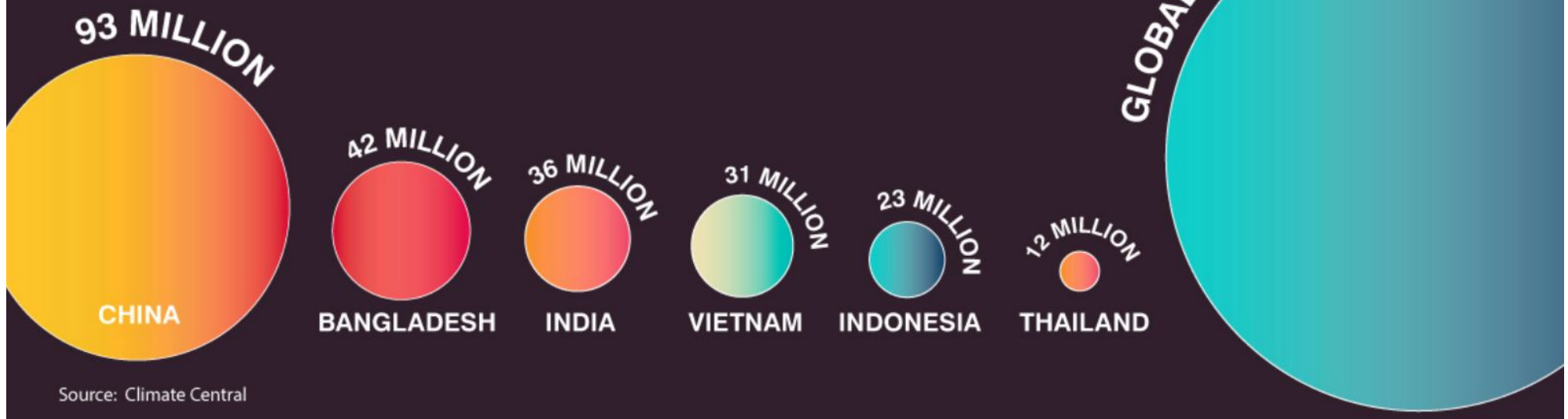
Source: Environmental Protection Agency, National Oceanic and Atmospheric Administration

EFFECTS OF CLIMATE CHANGE



Sea Level Rise

Seas are expected to permanently rise by 1 to 8 feet by 2100. By 2050, 300 million people—many below the poverty line—will live in regions prone to regular flooding.



Source: Climate Central

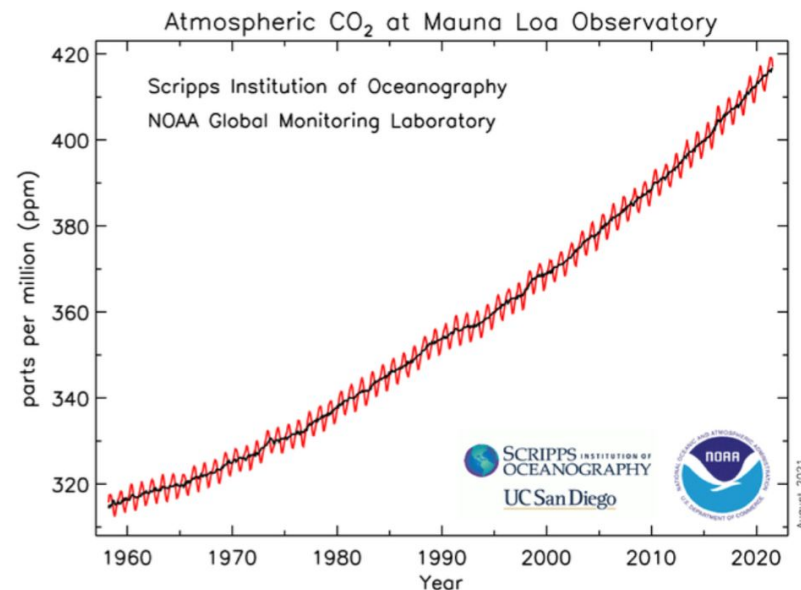
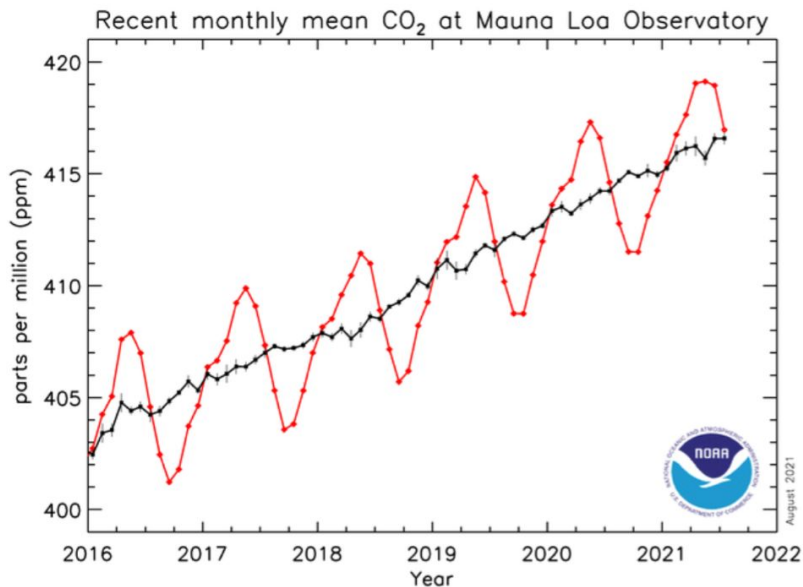
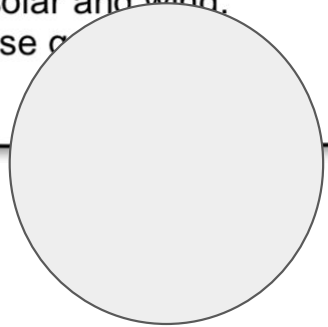
MORE EVIDENCE OF GLOBAL CLIMATE CHANGE

Increase in Greenhouse Gases

Carbon dioxide is a minor but very important component of the atmosphere. CO₂ is good at holding heat. Humans have increased atmospheric CO₂ concentration by more than a third since the Industrial Revolution began in the late 1700s-1800s.

Fossil Fuels Versus Renewable Resources

Fossil fuels were formed over millions of years from the fossils, or remains, of dead animals and plants buried under dirt and rock. Heat from inside the earth and pressure from dirt and rock changed the fossils into oil, natural gas, and coal. It took millions of years to make fossil fuels, we call them “nonrenewable fuels.” Fossil fuels were formed during the time of the dinosaurs. Renewable energy is from resources that are naturally replenished like solar and wind. Using renewable energy will reduce the amount of greenhouse gases released.



Ocean Acidification

Carbon dioxide dissolves in the ocean to make carbonic acid. The amount of acid has increased over the past 150 years.

These changes in ocean chemistry can disrupt the entire marine food web.

$\text{CO}_2 + \text{H}_2\text{O} = \text{H}_2\text{CO}_3$

The diagram is divided into three vertical panels illustrating the progression of ocean acidification. At the top, a factory with smokestacks is shown emitting CO2 into the atmosphere. White arrows point from the factory down to the ocean surface. In the center, a chemical equation shows a CO2 molecule (one black carbon atom, two red oxygen atoms) plus an H2O molecule (one white hydrogen atom, one red oxygen atom) equaling an H2CO3 molecule (one black carbon atom, two red oxygen atoms, and two white hydrogen atoms). Below this, the three panels show the increasing concentration of H2CO3 molecules in the water. The left panel, labeled 'pre-1850 average pH 8.2', shows a clear blue ocean with healthy coral reefs and a diverse population of fish and jellyfish. The middle panel, labeled 'current average pH 8.1', shows a slightly greener ocean with coral reefs that are partially bleached and fewer fish. The right panel, labeled 'future', shows a very green, acidic ocean with severely bleached and dying coral reefs and a significantly reduced and altered population of marine life.

pre-1850 average pH 8.2

current average pH 8.1

future

extra acid blocks growth of corals and shellfish

some species in the food web benefit while others decline