

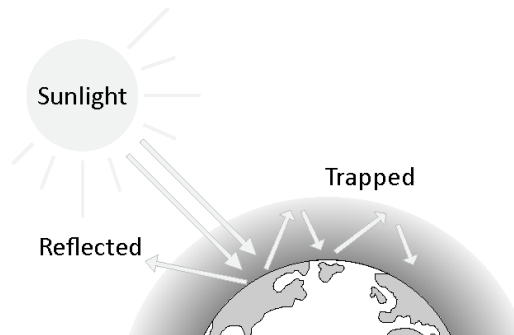
First some review of Climate Change:

Climate change

Weather: short-term (days, weeks, months) temperature and precipitation patterns.

Climate: long-term (30 year +) temperature and precipitation patterns.

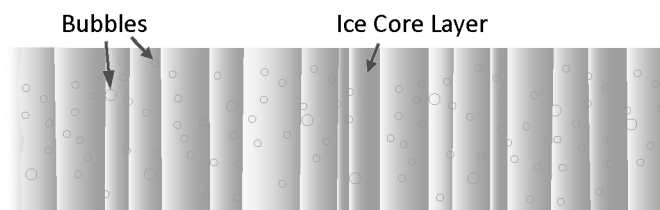
Greenhouse effect



Some sunlight is reflected back out to space. Greenhouse gases (e.g. carbon dioxide (CO_2), methane (CH_4)) in the atmosphere work to trap incoming solar radiation in the atmosphere. In this way, the level of carbon in the atmosphere plays a significant role in the overall global climate.

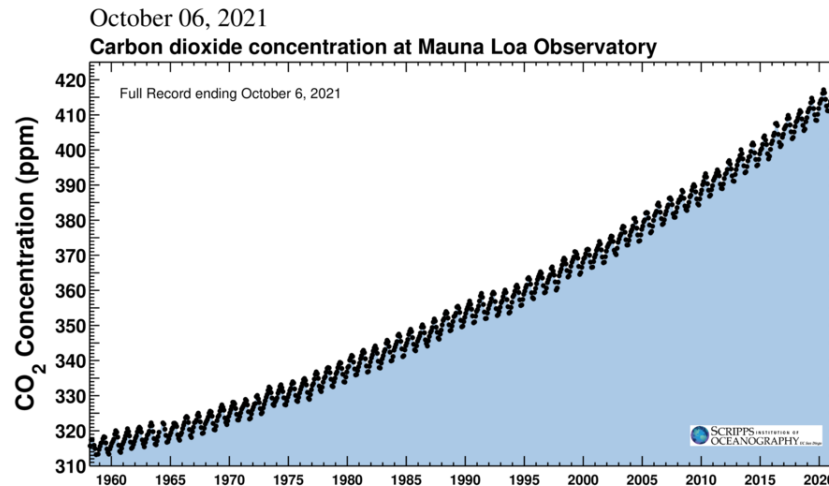
Evidence of change

Ice Cores



As ice accumulates in glaciers it will also trap bubbles of air. These bubbles can be analyzed to determine the concentration of greenhouse gases in the planet's atmosphere in the past. In some places of the Antarctic glaciers, these ice atmosphere records extend 100's of thousands of years into the past.

Atmospheric CO₂ Measurements



Known as the “Keeling Curve”, the concentration of CO₂ in the atmosphere has been measured at the Mauna Loa Observatory (Hawaii) since 1958. The general increase through time is striking, while the zig-zag pattern represents seasonal increase and decrease of biomass (plants) in the northern hemisphere. (CO₂ Keeling curve figure courtesy of UC-San Diego Scripps Institution of Oceanography)

Melting Glaciers

The Greenland and Antarctic ice sheets are shrinking. Most alpine glaciers are also shrinking.

Rising Sea-Level

When glaciers on land melt, that water is added to the oceans. Another cause of sea-level rise is due to the thermal expansion of seawater.

Ocean Acidification

Some of the CO₂ that is released into the atmosphere is absorbed by the oceans. This in turn increases the acidity of the ocean through the creation of carbonic acid.

Extreme Weather Events

Extreme weather systems such as hurricanes are driven by warm surface water. With increasing ocean surface temperatures, this leads to increased frequency, intensity, and duration of storms.

Now, test your knowledge:

1. True/False. The Earth's climate has changed in the past, therefore the current change is natural.
2. True/False. The science regarding human caused climate change is not settled, and there is a general lack in consensus amongst the science community.
3. True/False. An out of the ordinary significant snowfall event late into the spring would bring climate change science into question.
4. True/False. The greenhouse effect is bad and should be eliminated completely.
5. Eliminating the greenhouse effect would require:
 - A. Removing the all CO₂ and CH₄ from the atmosphere.
 - B. Removing the human added CO₂ and CH₄ from the atmosphere.
 - C. Removing the atmosphere.
 - D. Increasing the Nitrogen in the atmosphere.
6. Gases that are trapped in ice bubbles include:
 - A. CO₂ (carbon dioxide)
 - B. O₂ (molecular oxygen)
 - C. CH₄ (methane)
 - D. All of the above
7. The keeling curve increases exponentially, indicating _____.
 - A. the rate of CO₂ increase is steady.
 - B. changes in CO₂ levels can be observed between winter and summer.
 - C. the rate of CO₂ increase is accelerating.
 - D. the rate of CO₂ increase is slowing.
8. True/False. Melting of sea-ice (ice floating in the ocean) will cause sea levels to rise.

Now, think deeper:

On your own:

1. Read the following questions. Decide which you have a good answer for, or have some understanding already, and which you do not.
 - A. In most areas of the planet glaciers are retreating (getting smaller), but in some areas they are in fact growing. How is this possible?
 - B. The Earth's climate has changed in the past, so what's different about the change we see today? Why the concern?
 - C. Are scientists manipulating the data in order to show a warming trend?
 - D. CO₂ is only 0.04% of the atmosphere, how can that possibly have a large heating affect?
 - E. Is the sun increasing it's energy output and therefore causing the climate on Earth to change?

Working in groups of 2 or 3:

2. Discuss at least 2 of the above questions. Do you have similar answers? Write down areas where you disagree.
3. Decide as a group what is your most pressing remaining question regarding the above.