

TOPIC 4.4: CLIMATE CHANGE

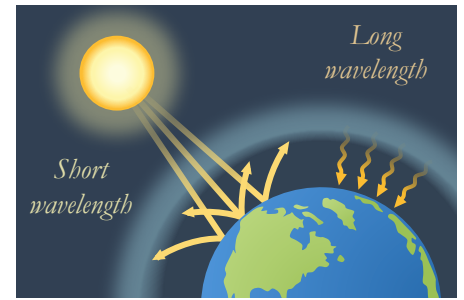
Greenhouse Effect

Greenhouse gases include carbon dioxide, water vapor, methane & nitrogen oxides

- Their impact depends on their concentration and ability to absorb IR radiation
- Water vapor and carbon dioxide are the most significant greenhouse gases

The greenhouse effect is a natural process that increases average temperatures:

- Incoming radiation from the sun includes short-wave ultraviolet (UV) radiation
- This radiation may be emitted by the Earth as long-wave infrared (IR) radiation
- Greenhouse gases absorb and re-emit this infrared radiation as heat



Carbon Dioxide Concentrations

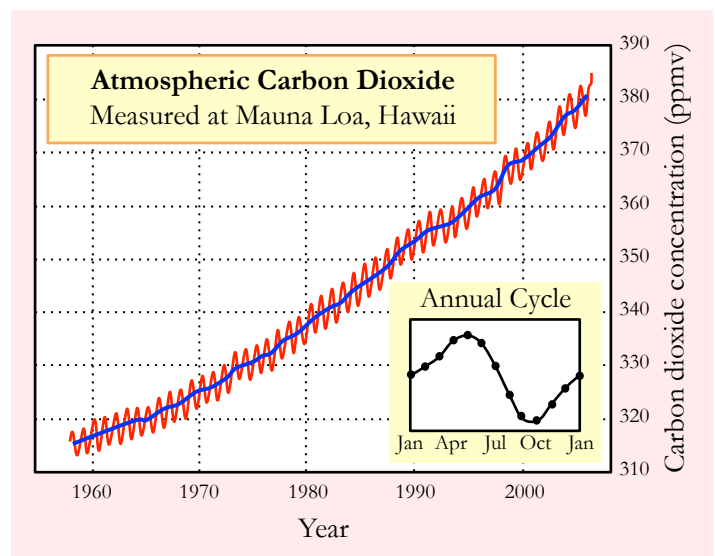
Carbon fluxes describe the amount of carbon transferred between various carbon pools (e.g. lithosphere → atmosphere)

Carbon dioxide concentrations are increasing within the atmosphere due to a number of human-induced activities:

- Industrial practices (i.e. combustion of fossil fuels)
- Deforestation (less CO₂ transferred to the biosphere)
- Agriculture (land clearing and methane production)

As global temperatures and climate patterns are influenced by greenhouse gases, increasing CO₂ concentrations may be causing global climate change (enhanced greenhouse effect)

- There is a positive correlation between rising CO₂ levels (since industrial revolution) and average global temperature



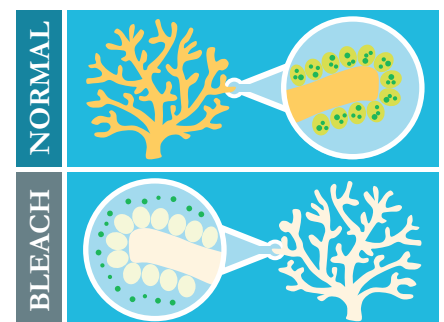
Ocean Acidification

The oceans are a major carbon sink (i.e. stores CO₂ from the atmosphere)

- Some of the CO₂ remains dissolved, but most of it is chemically converted
- CO₂ is converted into carbonic acid, which dissociates to release H⁺ ions

This conversion impacts marine organisms (such as coral) in a number of ways:

- It increases ocean acidity, which can stress coral survival (↑ H⁺ = ↓ pH)
- It lowers carbonate levels, which is required for shells and exoskeletons
- These conditions can cause coral to expel mutualistic algae (coral bleaching)



Climate Change Debate

Is current climate change natural?

Claim:

Historical data show temperature cycles

Counter:

Past changes were not as abrupt

Ocean levels are rising, pH decreasing

Are greenhouse gases the cause?

Claim:

Changes could be caused by sunspots

Counter:

Climate changes don't match sun activity

CO₂ levels are highest ever recorded

Are climate models reliable?

Claim:

Models may make varying predictions

Counter:

All the climate models are predicting a temperature increase by 2100 (~2–6°C)