4.4 Climate Change

Greenhouse Gases

Identify the most common greenhouse gas within the Earth's atmosphere

Water vapour

List four other greenhouse gases

Carbon dioxide, methane, nitrogen oxides, fluorinated gases (e.g. CFCs)

Identify the two main factors that determine the impact of a greenhouse gas

1. Ability to absorb long-wave radiation
2. Concentration within the atmosphere (determined by rate of release and persistence)

Describe the changes in atmospheric carbon dioxide levels detected at the Mauna Loa Observatory

Carbon dioxide levels fluctuate annually

(lower in summer = higher photosynthetic rate)

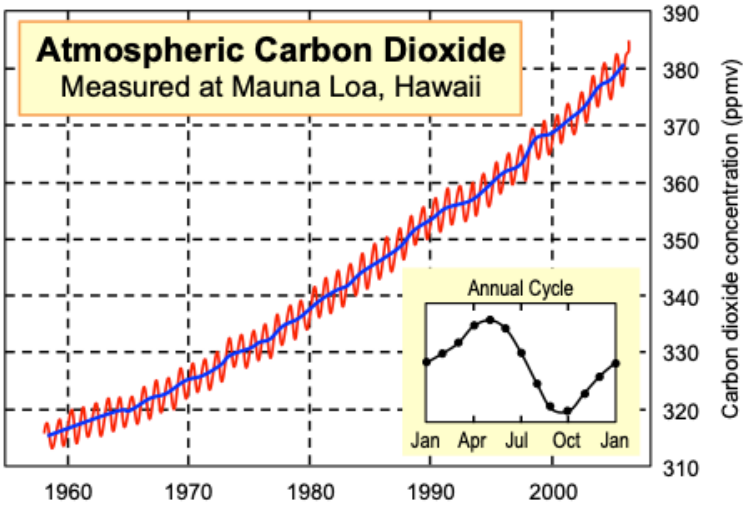
Carbon dioxide levels are steadily increasing

(due to increased burning of fossil fuels)

Global trends conform to northern hemisphere

(due to more people and more land mass)

CO2 levels are now the highest ever recorded



Climate Patterns

Explain the relationship between greenhouse gases and the greenhouse effect

The greenhouse effect functions to trap heat within the atmosphere and prevent rapid temperature changes

Incoming radiation (from the sun) is shorter wave radiation (e.g. ultraviolet radiation and visible spectrum)

The Earth's surface absorbs this radiation and re-emits it at a longer wavelength (i.e. infrared radiation / heat)

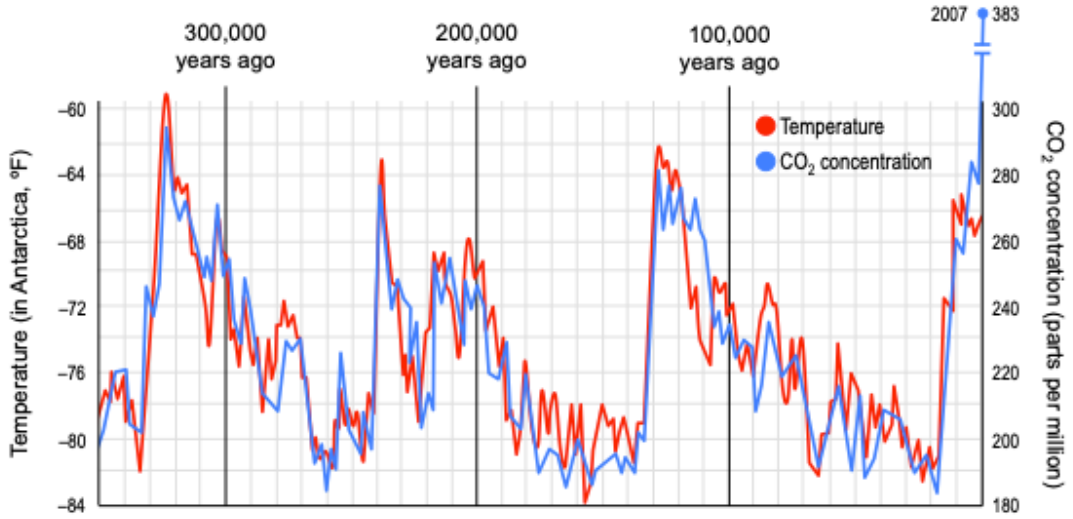
Greenhouse gases absorb and re-radiate the longer wave radiation and hence retain heat in the atmosphere

The higher the concentration of greenhouse gases in the atmosphere, the more heat is retained

List three climate conditions that are influenced by greenhouse gases

1. Global temperatures (increasing)
2. Weather conditions (more frequent extreme conditions)
3. Ocean currents (changes can cause longer El Nino events)

Analyse the data to describe the relationship between carbon dioxide levels and global temperatures



There is a strong positive correlation between carbon dioxide levels and global temperatures

There have been fluctuating cycles that can be attributed to global warm ages and ice ages

CO2 levels are the highest ever recorded (however CO2 increases may not always precede temperature increases)

Explain how increasing concentrations of atmospheric carbon dioxide threatens coral reefs

Increased concentrations of dissolved carbon dioxide lowers ocean pH (more carbonic acid = more acidity)

More hydrogen ions also means there are less free carbonate ions for calcification (shell formation)

Hence, an increase in water acidity correlates with significant thinning of calcium exoskeletons

Low pH conditions are also detrimental to polyp survival, leading to coral bleaching

List two arguments against human-induced climate change and provide a counterpoint to each

Argument 1: Current climate change is caused by solar activity

Counterpoint: There is no evidence of an increased number of sunspots

Argument 2: Current climate changes reflect a natural climatic cycle

Counterpoint: Changes do not usually occur as abruptly and past abrupt changes were always destructive to life