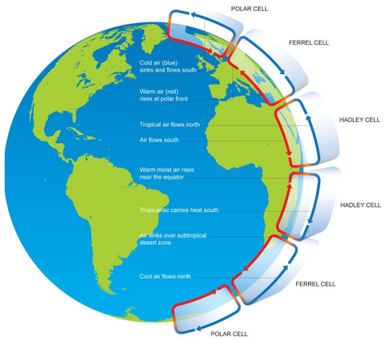
Unit 1: Topic 1a Hazardous Earth—Climate Change

How does the worlds climate system function?

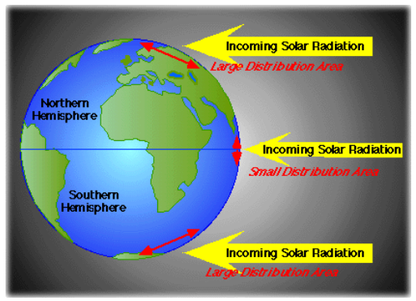
What is Global/Atmospheric Circulation?

The atmosphere is constantly moving - transferring heat around the earth in a global circulation system. There are three types of circulation cells that make up this circulation pattern.

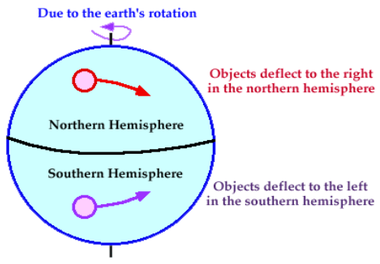


The earth receives its energy from the sun which passes through the atmosphere and heats up the ground directly. This warms the air above the ground, the warm air rises and transfers heat into the atmosphere which creates low pressure. It then cools, travels north and south where it sinks back towards the earth. Rising air cannot hold as much moisture that's why there is more precipitation on the equator. As the cooler, drier air sinks (30°N/S line of latitude) it creates high pressure with clear skies, little precipitation and arid (dry) conditions.

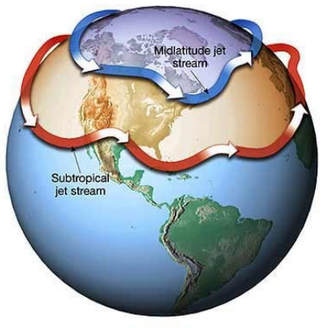
The earth receives most **radiation** on the equator where it is hottest compared to the poles where it is the coldest. The equator receives most radiation because the suns rays hit the surface at a right angle. At the poles the angle is much lower which means they have to heat up a much larger area.



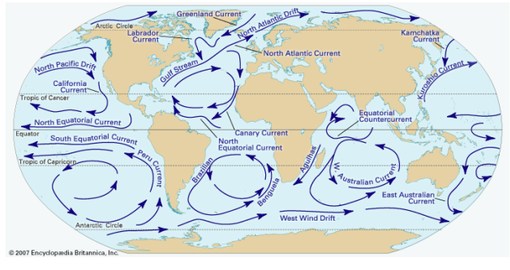
Winds are caused when air moves from high to low pressure but because the earth rotates as the air moves above the surface, the earth rotates below it and the winds follow a curved path. This is called the **coriolis effect**. In the northern hemisphere the winds are deflected to the right and in the southern hemisphere to the left.



Jet streams also impact on air movement and they are mainly on the boundaries of the main circulation cells changing the weather for different places.



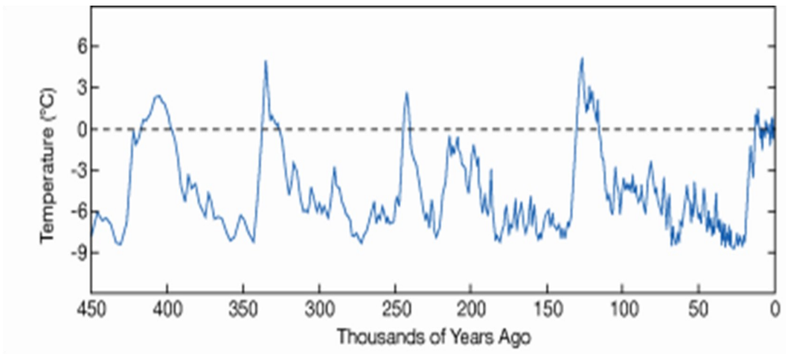
Oceanic currents also transfer heat around the earth. Surface ocean currents are driven by the movement of air across them, whereas deep ocean currents are determined by colder salty water near the Arctic and Antarctic sinking pulling warmer water into them from lower latitudes.

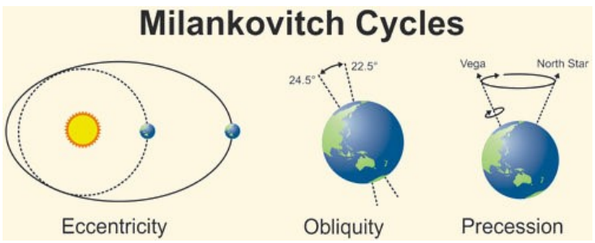


What are the natural causes of climate change?

Weather changes from minute to minute, climate is the average weather taken over 30 years. In historical times temperatures have varied as much as 1.5°C each side of the average due to natural causes.

Throughout history the earths temperatures has changed many times both increasing and decreasing. There are many reasons for these changes:





Orbital Changes: (**Milankovitch** cycles) Changes in how the earth orbits the sun. These cycles are called the Milankovitch cycles and happen every 100,000 years. The earths orbit changes from being circular to elliptical (more egg shaped) and this changes the amount of solar energy the earth surface receives.

Solar Output: (sunspot activity) The suns energy output is not always constant, the most common of these are sunspots, these are darker areas on the sun surface with greater amounts of solar activity. Sunspots come and go usually every 11 years, the more sunspots the higher the temperature on earth.

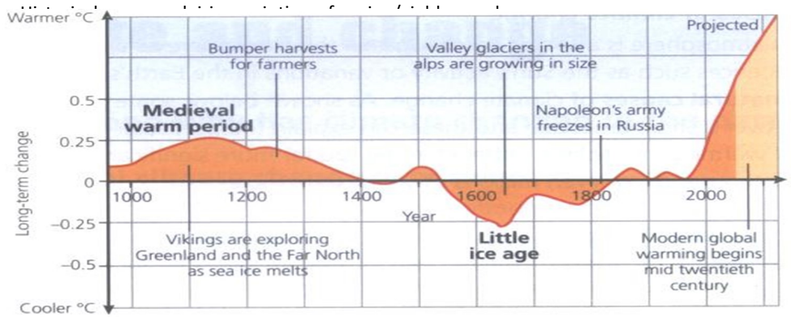
Volcanic Activity: Major volcanic events lead to reduced temperatures as the volcano erupts large amounts of ash into the atmosphere. This blocks out solar radiation and reduces the amount of suns energy reaching the earths surface and therefore reducing the temperature.

Asteroid Collisions: Can lead to small periods of cooling due to the ash/dust particles put into the atmosphere following the collision with earths surface. As with volcanic activity these also block out or absorb solar radiation.

What evidence is there of natural climate change?

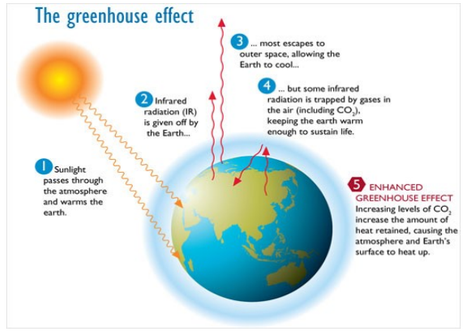
We know about climate change in the past because of:

- Tree rings. Growth rings are wider indicating warmer wetter conditions.
- Ice cores from Greenland and Antarctica indicating levels of CO_2 from when the ice was formed.



What is the Greenhouse Effect?

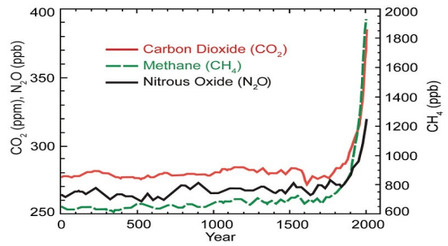
There are a number of greenhouse gases, methane, nitrous oxide but the one most associated with human activity is carbon dioxide. Recent changes in CO_2 are a result of burning fossil fuels such as gas, coal and above all oil.



1. Greenhouse gases retain heat from the Sun that would otherwise be reflected from Earth back into space. Without them the planet would be too cold to support life.
2. Solar energy passes through the atmosphere without having any real impact on it.
3. About half of it is absorbed by the Earth, the rest is reflected back by clouds or the ground, absorbed by the clouds or upper atmosphere or simply scattered back to space.
4. The other half absorbed by the ground is radiated back into the atmosphere and some is trapped by greenhouse gases.

How are human activities causing climate change?

What is the 'Enhanced' Greenhouse Effect?– human activities have increased the amount of CO_2 and have reduced the environment ability to absorb it. Since the industrial revolution levels of greenhouse gases have risen. The developed world are responsible for the majority of this increase as a result of the following:



- energy supply which burns coal, gas and oil. US and China majority coal (39% CO_2)
- 90% of journeys use transport which burns oil (29% CO_2)
- manufacturing industry uses energy and produces waste (17% CO_2)

Other greenhouse gases have different origins:

- Nitrous oxide is produced by jet engines, fertilisers and sewage farms.
- Methane from grazing cows (200 litres of gas per day). Cattle numbers have doubled in last 50years.
- Deforestation by humans leads to an increase in CO_2 emissions as these are carbon stores and without them this reduces the ability of the earth to absorb CO_2.

What are the possible consequences of climate change?

Sea level changes

The most obvious impact of climate change is and rising temperatures is rising sea levels. Sea levels have risen by around 200mm since 1870. This is due to two main reasons:

- As temperatures rise, water expands causing sea volume to increase.
- Melting ice caps and glaciers, most is held in Greenland and Antarctica

There could be a rise in sea levels by 300mm to 1000mm depending on how we look at global warming. Melting ice can unlock greenhouse gases such as Methane that have been locked away for centuries, increasing the greenhouse effect further.