GCSE GEOGRAPHY KNOWLEDGE BOOK

UNIT 1
Living with the Physical Environment

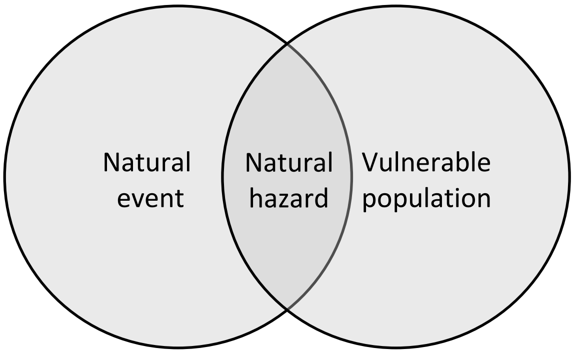
Section A:
The Challenge of Natural Hazards

- Natural Hazards
- Tectonic Hazards
- Weather Hazards
- Climate Change

The information here is what all students MUST know. Use this document as a checklist to identify what is clear to you, what you need to work on and what you can tick off once revised. If you have any doubts or questions, please come and see your teacher – we are happy to help!

NATURAL HAZARDS

<table>
<tr><th>Key content</th><th>What you need to know</th></tr>
<tr><td>Natural hazard definition</td><td>A natural hazard is a natural event such as an earthquake, volcanic eruption, tropical storm or flood. It is caused by ‘natural’ processes, so would occur even if humans were not on the planet. It is a ‘hazard’ because it has the potential to cause damage, destruction and death when it interacts with humans.



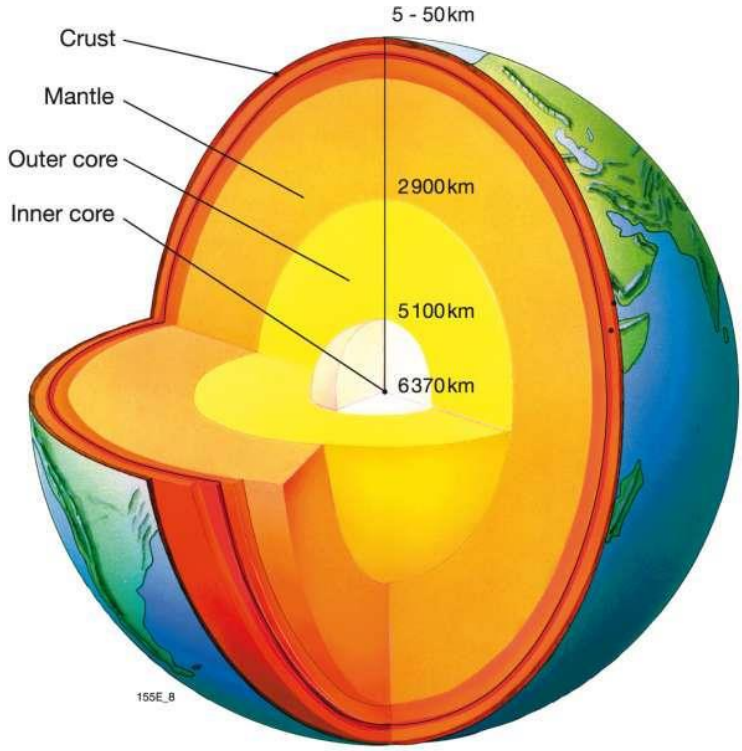
</td></tr>
<tr><td>Factors affecting hazard risk</td><td>Hazard risk is the probability or chance that a natural hazard may take place. It increases when:

There is an increase in the number of people vulnerable to the hazard (global population increase, more people settling near hazard prone areas).
There is an increase in the frequency and magnitude of the hazard (global warming leading to stronger tropical storms, earthquakes may be closer to the surface or have a higher magnitude on the Richter scale).
A decrease in the number of people able to cope with the natural hazard (prediction, preparation, planning and protection may be less effective in LICs).
</td></tr>
</table>

TECTONIC HAZARDS

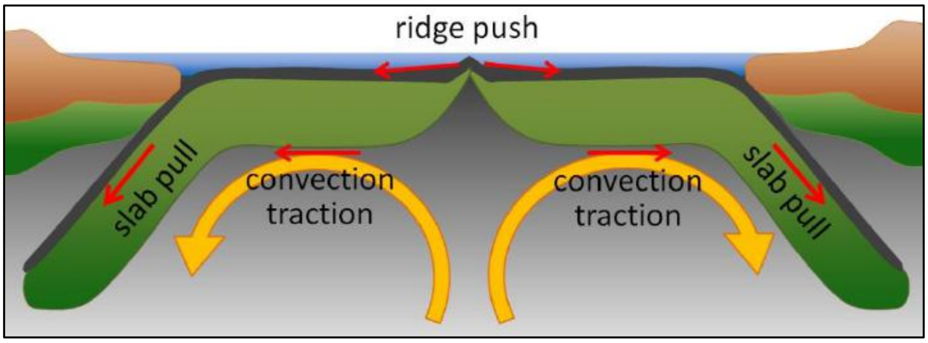
<table>
<tr><td>Earth’s Structure</td><td>The crust and upper mantle are called the lithosphere which is broken up into several fragments known as tectonic plates. Plates are rigid and move slowly as they float across semi-molten rock in the mantle. Continental plates are less dense but thicker than oceanic plates.

Inner core: Composed of solid iron and nickel but with temperatures of 6000°C.
Outer core: Composed of liquid iron and nickel. Temperatures are 5000°C.
Mantle: Composed of molten rock which is heated up by the core. It has huge convection currents running through it.
Crust: the thinnest layer which is divided into tectonic plates.</td></tr>
</table>

<table>
<tr>
<td></td>
<td>


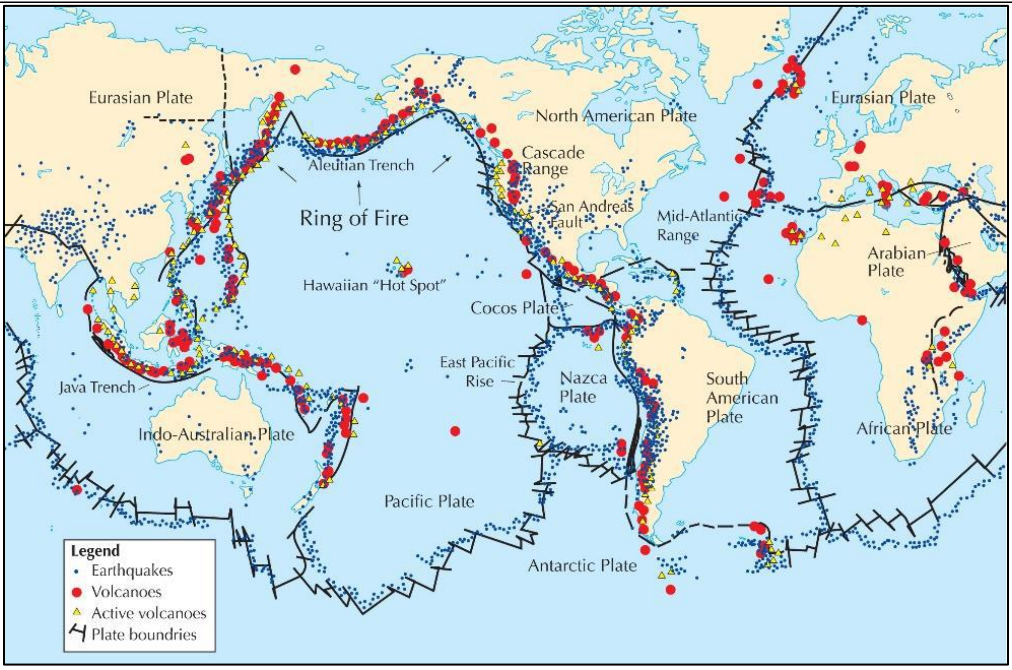
</td>
</tr>
<tr>
<td>What causes tectonic plates to move?</td>
<td>
There are two theories:
Convection: The hot core causes magma to rise in the mantle and sink towards the core as it cools.

Current main theory is ridge push and slab pull:
Ridge push is when magma rises as the plates move apart. The magma cools, becomes denser and slides down away from the newly created ridge. this causes the plates to move away from each other.
Slab pull: denser plate sinks back into the mantle under the influence of gravity and pulls the rest of the plate with it.



</td>
</tr>
</table>

Tectonic plate distribution

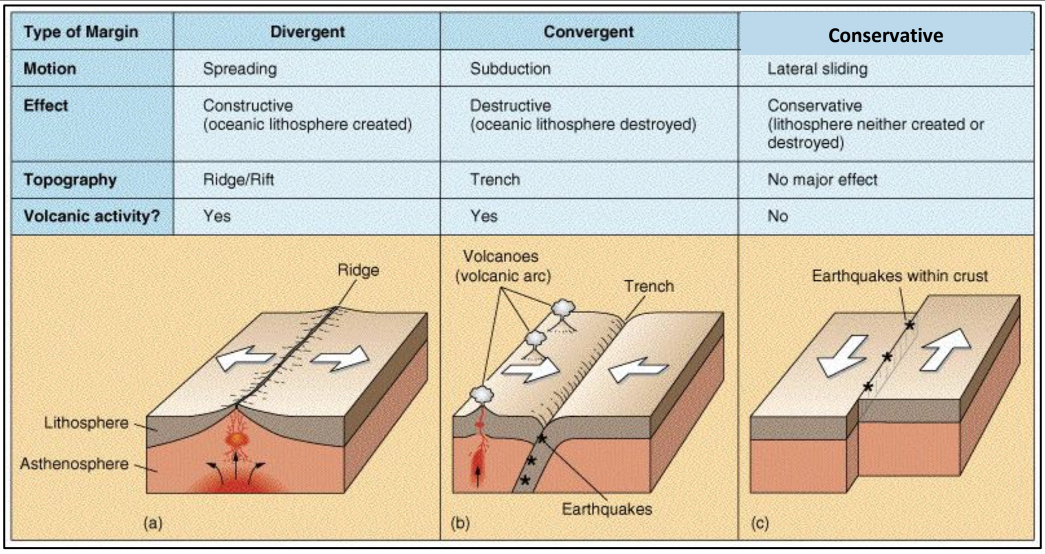


The distribution of tectonic activity is not random. They occur in narrow bands along plate boundaries.

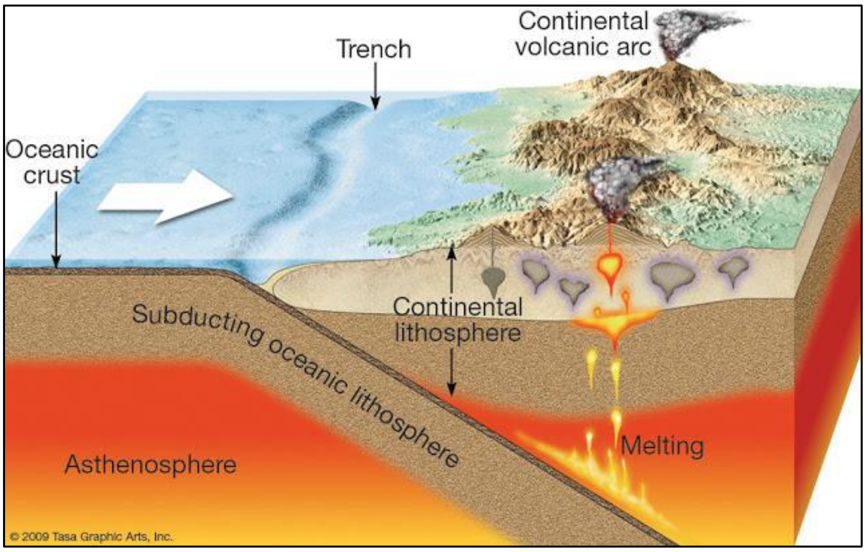
Earthquakes form at all three boundary types: **constructive, destructive, conservative.**

Volcanoes form at **constructive** and **destructive** boundaries.

Physical processes at plate boundaries



Type of Margin	Divergent	Convergent	Conservative
Motion	Spreading	Subduction	Lateral sliding
Effect	Constructive (oceanic lithosphere created)	Destructive (oceanic lithosphere destroyed)	Conservative (lithosphere neither created or destroyed)
Topography	Ridge/Rift	Trench	No major effect
Volcanic activity?	Yes	Yes	No



A closer look at a **Destructive plate margin** with trench, volcano and fold mountains as key landforms.

<table>
<tr>
<td>What are the effects of tectonic hazards?</td>
<td>

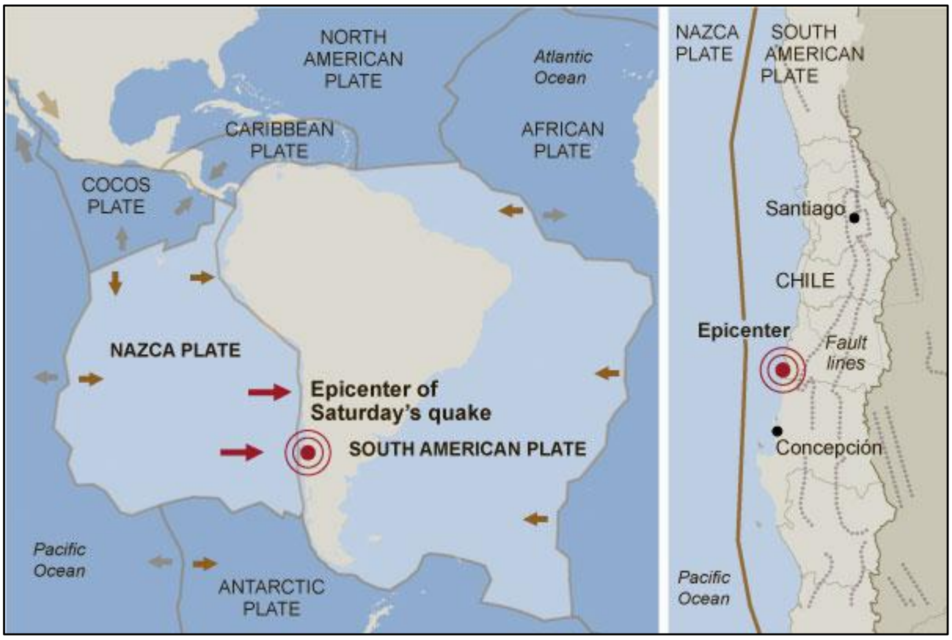
Effects come in two forms; **primary** and **secondary.**

Primary effects of an earthquake occur as a direct result of the hazard taking place. E.g. property and buildings destroyed, people injured or killed, infrastructure such as roads and water pipes damaged.

Secondary effects come as a result of the primary effects.
E.g. business reduced and money spent repairing damage causing the economy to slow. Blocked infrastructure such as roads hinders emergency services causing casualty rates to rise in number and severity. Burst water pipes lead to lack of clean water which increases chance of diseases spreading.

</td>
</tr>
<tr>
<td>CASE STUDY Earthquake in an HIC</td>
<td>

<u>Maule, Chile, (2010)</u>



Background
In global terms, Chile is ranked 38th out of 193 countries based on Gross Domestic Product (the country's wealth). It is ranked 41st out of 187 countries based on the Human Development Index (measure of wealth, health and education).

Causes
On 27th February 2010, the ground just off the coast of Central Chile shook for three minutes when a powerful magnitude 8.8 earthquake struck (Figure 2). The earthquake occurred at a destructive plate margin where the Nazca Plate is subducting (moving beneath) the South American Plate. It was followed by a series of aftershocks.

The earthquake occurred out to sea sending tsunami waves across the Pacific Ocean at speeds of 800km per hour.

Primary Effects

- Around 500 people killed and 12 000 injured – 800 000 people were affected.
- 220 000 homes, 4500 schools, 53 ports and 56 hospitals were destroyed.
- Port of Talcahuano and Santiago airport was badly damaged.
- Much of Chile lost power, water supplies and communications.
- Cost of earthquake estimated at $30billion US dollars.

Secondary Effects

- 1500km of roads damaged, mainly by landslides.
- Remote communities cut off by landslides for many days.
- Several coastal towns devastated by tsunami waves.
- A fire at a chemical plant near Santiago caused the area to be evacuated.

</td>
</tr>
</table>

Immediate Responses

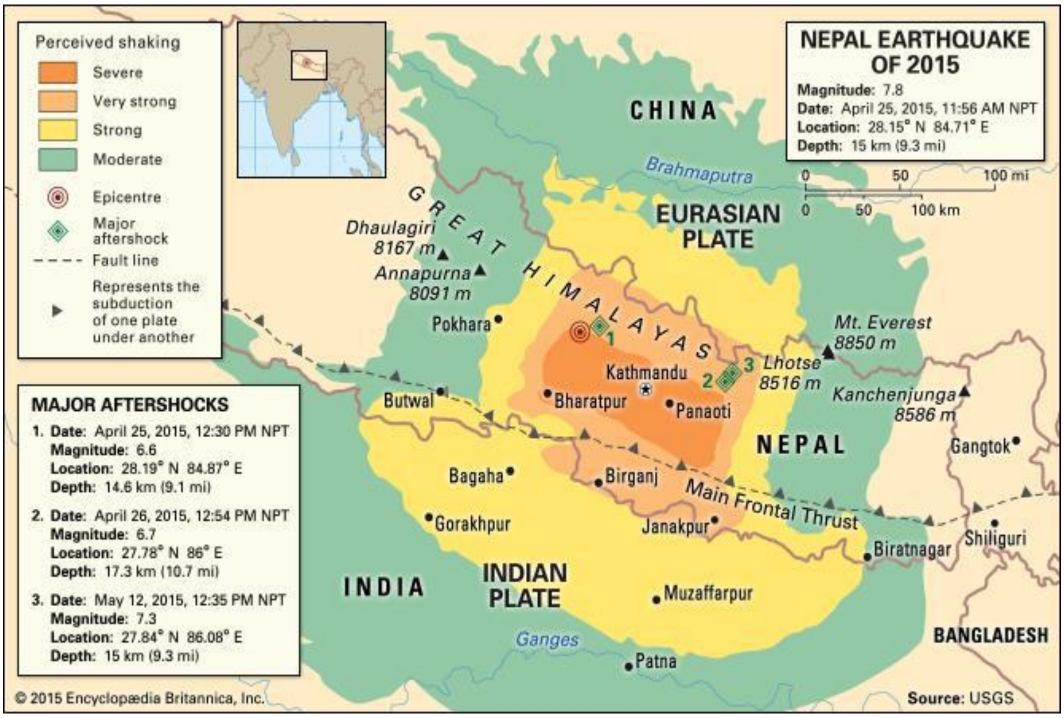
- Emergency services acted swiftly. International help was needed to supply field hospitals, satellite phones and floating bridges.
- Temporary repairs made to the important Route 5 north-south highway with 24 hours, enabling aid to be transported.
- Power and water restored to 90% of homes within 10 days.
- A national appeal raised $60million US dollars – enough to build 30 000 small emergency shelters.

Long-term Responses

- A month after the earthquake Chile's government launched a reconstruction plan to help nearly 200 000 homes affected.
- Chile's strong economy based on copper exports could be rebuilt without the need for much foreign aid.
- President announced it could take up to four years for Chile to recover fully from the damage to buildings and ports.

CASE STUDY Earthquake in an LIC

<u>**Gorka, Nepal, (2015)**</u>



Background

In global terms, Nepal is ranked 109th out of 193 countries based on Gross Domestic Product (the country's wealth). It is ranked 145th out of 187 countries based on the Human Development Index (measure of wealth, health and education). Where a country is ranked 1st, this means they have the best out of the countries involved.

Causes

On 25th April 2015 Nepal was struck by a magnitude 7.9 earthquake on the Richter scale. The epicentre was about 80km (50 miles) to the north west of Nepal's capital Kathmandu in the foothills of the Himalayas (Figure 1). This is a destructive plate margin where the Indo-Australian Plate is colliding with the Eurasian Plate at a rate of 45mm per year. The collision and pressure at this margin is responsible for the formation of the Himalayas.

The earthquake was very shallow, just 15km below the surface. This resulted in very severe ground shaking and widespread landslides on the Himalayas and avalanches on Mount Everest. The earthquake caused damaged hundreds of kilometres away in neighbouring India, Tibet and Pakistan. There were three notable aftershocks of M6.6, M6.7 and M7.3

<table>
<tr>
<td></td>
<td>
Primary Effects

9000 people died, and 20 000 people were injured – A total of 8 million (1/3 of Nepal's population) were affected).
Electricity, water supplies, sanitation and communication affected.
1.4 million people needed food, water and shelter days after the earthquake.
7000 schools and 500 000 homes destroyed, and hospitals were overwhelmed.
50% of shops were destroyed affecting food supplies and people's livelihoods (income).
Cost of damage was estimated to be over $5billion US dollars.

Secondary Effects

3 million people left homeless when homes were destroyed.
Ground shaking triggered landslides and avalanches, blocking roads and delaying rescue efforts.
Avalanches on Mount Everest killed at least 19 people – the greatest loss of life on a mountain in a single incident.
An avalanche in the Langtang region left 250 people missing.
Landslides blocked the Kali Gandaki River causing people to be evacuated in case of flooding.
Reduced tourism from Mount Everest and the Dharahara Tower; a world heritage site which was damaged caused a decline in employment and income.

Immediate Responses

International help was requested.
Search and rescue teams, water and medical support arrived quickly from countries such as UK, India and China.
Helicopters rescued people on Mount Everest and delivered supplies to villages cut off by landslides.
500 000 tents were provided.
Field hospitals were set up and the United Nations and World Health Organisation sent medical supplies to badly affected areas.
Facebook launched a safety feature allowing users to indicate they were safe. Free telephone calls.
300 000 migrated from Kathmandu to seek shelter and supplies.

Long-term Responses

Roads were repaired, and landslides were cleared. Lakes, formed by landslides damming river valleys need to be emptied to avoid floods.
Stricter laws on buildings codes.
New trekking routes opened on Mount Everest and permits were extended by 2 years.

</td>
</tr>
<tr>
<td>How can risks from tectonic hazards be reduced?</td>
<td>
Volcanologists and seismologists use monitoring, prediction, protection and planning to reduce death and destruction caused by earthquakes and volcanoes.

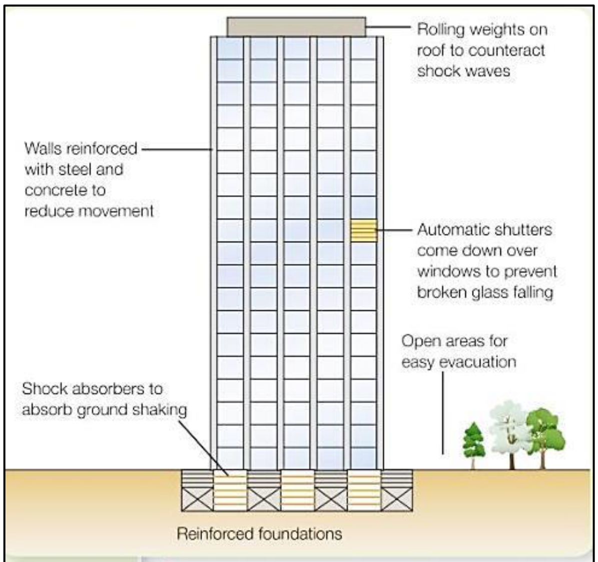
<u>Monitoring</u>
Earthquakes are more difficult to monitor than volcanoes but radon gas leaks and foreshocks using seismometers and GPS can be used.

Volcanoes can be monitored through the use of:
Remote sensing – using satellites to detect heat and changes to the volcanoes shape
Seismicity – seismographs record the earthquakes which precede an eruption
Ground deformation – laser beams can be used to record changes to the shape of a volcano
Geophysical measurements – detect changes in gravity as magma rises to the surface
Gas measurements – instruments detect gases released as magma rises to the surface.
</td>
</tr>
</table>

Prediction

Volcanic eruptions are easier to predict than earthquakes as they usually give advanced warning signs before erupting which can be monitored by scientists.

It is impossible to make accurate predictions about **earthquakes** due to a lack of clear warning signs. However, scientists studying historical records of earthquakes at plate margins have identified locations that they believe are at great risk, for example the city of Istanbul in Turkey. Indeed, in September, 2019 there was a 5.8 magnitude earthquake in Istanbul.



Features of an earthquake-resistant building

Protection

There is little which can be done to protect people from a **volcanic** eruption. However, it is possible to use earth embankments or explosives to divert lava flows away from property.

With **earthquakes**, it is possible to construct buildings and bridges to resist the ground shaking (see right). In Chile for example, new buildings have reinforced concrete columns strengthened by a steel frame. Regular earthquake drills can also help to keep people alert and prepared. Tsunami walls can also be built on coastal areas vulnerable to earthquakes to protect against these huge waves.

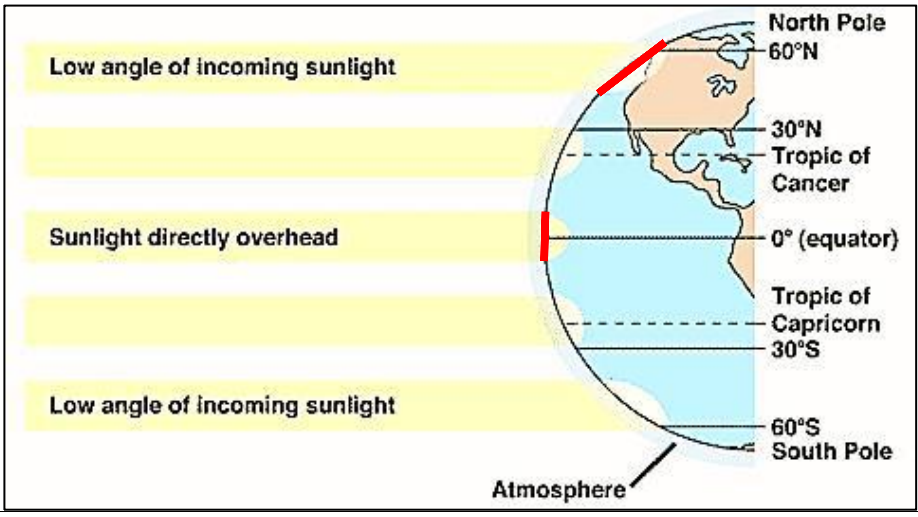
Planning

Hazard maps have been produced for many of the world's most dangerous **volcanoes**, showing the areas likely to be affected. They can be used when planning to restrict certain land uses or identify those areas which need to be evacuated when an eruption is about to happen.

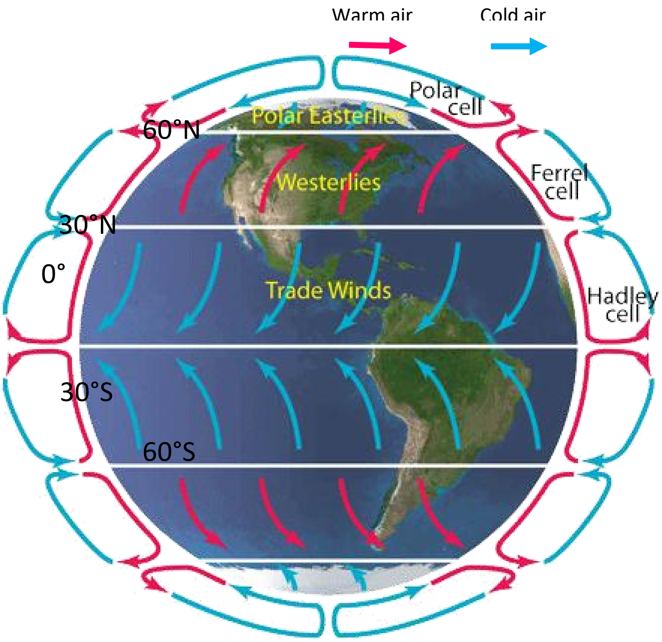
With **earthquakes**, maps can be produced to show the effects of an earthquake or to identify those areas which would be most at risk of damage. High value land-uses can then be protected in these vulnerable areas. In addition, homeowners can benefit from securing objects and furniture and keeping emergency survival kits close at hand.

WEATHER HAZARDS

<table>
<tr>
<td>What is the influence of latitude?</td>
<td>When the sun’s rays strike the Earth they are concentrated differently on areas of the planet according to latitude and therefore, curvature of the earth. At the equator the Sun’s rays are concentrated so it is hotter than at the poles where the rays are more spread out. Look at the difference in length of the red lines on the diagram.

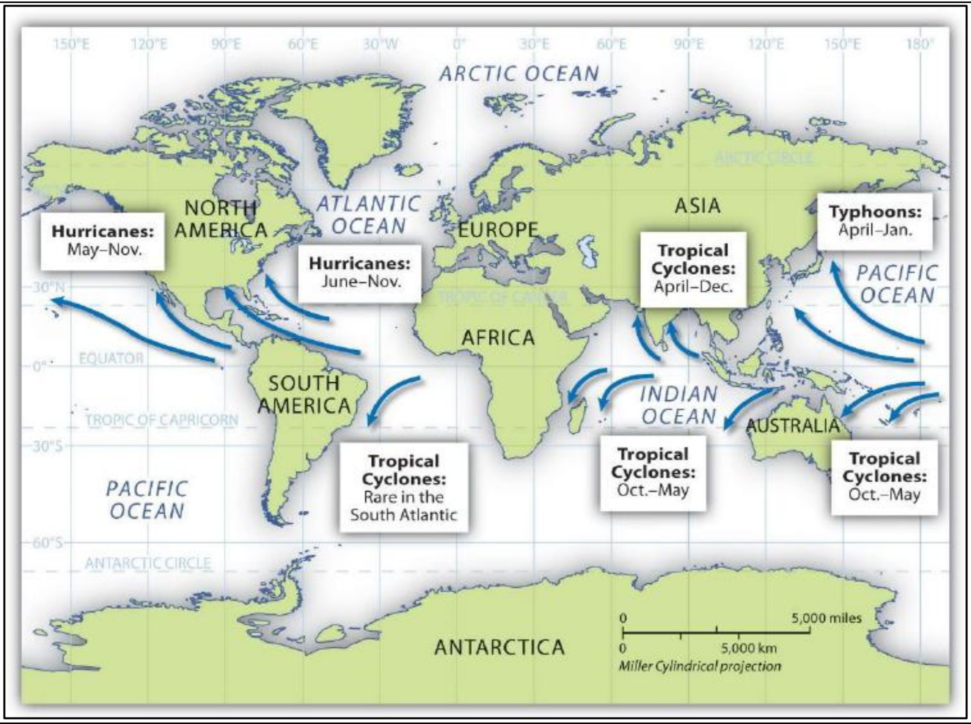


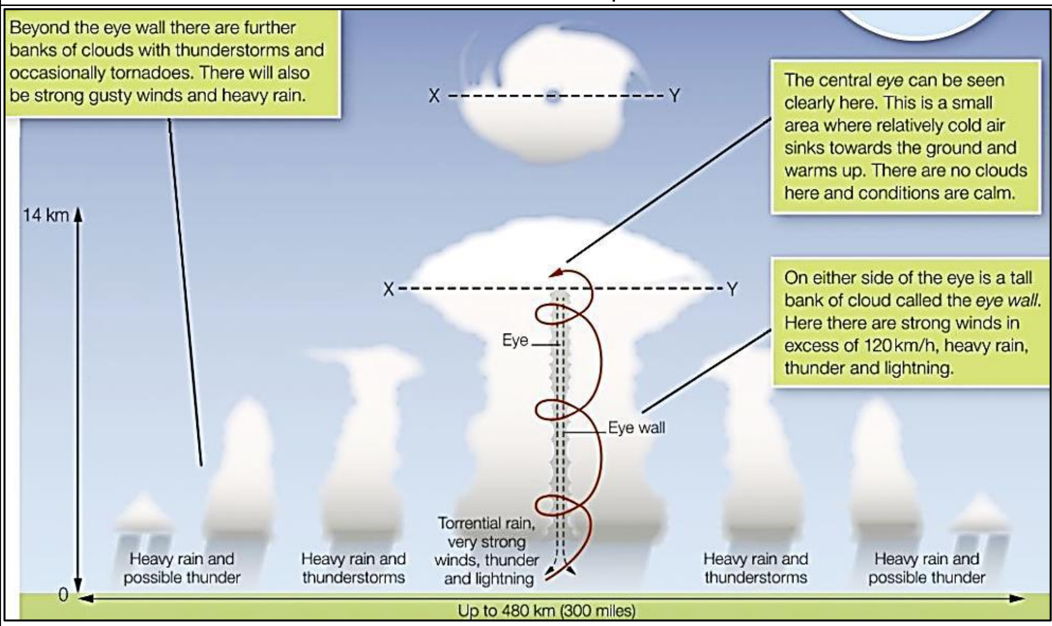
</td>
</tr>
<tr>
<td>How does global atmospheric circulation work?</td>
<td>Pressure belts
1.Air at the equator is heated so it rises in low pressure conditions. The air flows towards the North and South Poles. As warm air rises it cools and condenses bringing clouds and rain.
2.The air sinks at 30° latitude under high pressure. High pressure weather brings dry and clear skies. This forms the Hadley Cell.
3.Air at the polar latitudes is colder and denser so the air sinks under high pressure conditions. The air flows towards the Equator. The air warms as it reaches 60°and again rises under low pressure conditions. This forms the Polar cell. The Ferrel cell is located between the Hadley and Polar cell.



Surface winds
Winds occur as air moves from high to low pressure areas in the convection cells. These winds bend on the surface due to the Coriolis Effect as the Earth spins. Winds bend to the right in the northern hemisphere, and to the left in the southern hemisphere.</td>
</tr>
<tr>
<td>Where are tropical storms found?</td>
<td>Tropical storms are a natural atmospheric hazard and have different names according to where they occur on the planet. They occur between 5 and 30° north and south of the Equator. Here, an area of intense low pressure allows warm, moist air to rise rapidly to reach high altitudes.

Conditions which cause tropical storms:
Low latitudes (5-30°north and south of the Equator), oceans with temperatures above 27°C, ocean depths of 60-70m, between summer and autumn, low wind shear.</td>
</tr>
</table>

<table>
<tr>
<td></td>
<td>


</td>
</tr>
<tr>
<td>Sequence of tropical storm formation</td>
<td>
1. Air is heated above warm tropical oceans
2. Warm air rises rapidly (low pressure)
3. Strong winds form as rising air draws up more air and moisture
4. Rising air spins around the calm eye of the storm due to the Coriolis effect
5. Rising air cools and condenses, forms large cumulonimbus clouds and torrential rain.
6. Heat is given off as it cools, powering the storm
7. Cold air sinks in the eye so it is clear, dry and calmer
8. The tropical storm travels across the ocean with the prevailing wind
9. When it reaches land, it loses its source of heat and moisture so loses power.
10. Storms travel north in the northern hemisphere and south in the southern hemisphere
</td>
</tr>
<tr>
<td>Structure of a tropical storm</td>
<td>


Tropical storms spin anticlockwise in the northern hemisphere and clockwise in the southern hemisphere.
</td>
</tr>
<tr>
<td>How might climate change affect tropical storms?</td>
<td>
Climate change rises atmosphere and sea surface temperatures. This will affect tropical storms in the following ways:
Distribution: There may be more in the South Atlantic and parts of the subtropics.
Frequency: The number of storms is not expected to change but the frequency of stronger storms is (category 4 and 5). Category 1-3 storms however, are expected to decrease.
Intensity: Since the 1970s the number of the most severe storms has increased. Every 1 degree Celsius increase in sea temp = a 3-5% increase in wind speed.
</td>
</tr>
</table>

CASE STUDY Tropical Storm

<u>Typhoon Haiyan, Philippines, 2013</u>

Causes

Typhoon Haiyan struck the Philippines, South East Asia on the 8th November 2013. It was a category 5 storm on the Saffir-Simpson scale. It was one of the most powerful storms to ever hit the Philippines. The tropical storm brought winds of up to 314 kilometres per hour, waves as high as 15 metres and 400 millimetres of heavy precipitation flooding 1km inland from the coast. 90% of the city of Tacloban was destroyed.

Primary Effects

Social

- 50% of houses destroyed.
- 4.1 million made homeless.
- 6,190 people died.

Economic

- Damage cost was $12 billion US dollars.
- Damage to rice cost $53 million US dollars.
- The United Nations stated 75% of farmers and fishermen had lost their income.

Environmental

- An oil barge ran aground causing an 800 000-litre oil spill.
- 400 millimetres of rainfall caused flooding.
- 1.1 million tonnes of crops were destroyed.

Secondary Effects

Social

- Infection and disease spread due to contaminated water.
- Power supplies were cut off for a month in some areas.
- Many schools were destroyed.

Economic

- Fishing industry was disrupted as the leaked oil from the grounded barge contaminated fishing water.
- The airport was badly damaged, and roads were blocked by trees and debris.
- Looting and violence was rife in Tacloban, due to a lack of food and supplies.
- By 2014, rice prices had risen by nearly 12%.

Environmental

- Ten hectares of mangroves (saltwater-adapted trees or shrubs) were contaminated by the oil barge leak.
- Flooding caused landslides.

Immediate Responses

- The government televised a warning for people to prepare and evacuate.
- Authorities evacuated 800 000 people. Many went to Tacloban Indoor Stadium, which had a reinforced roof to withstand typhoon winds, however, it flooded.
- Over 1 200 evacuation centres were set up to help the homeless.
- Emergency aid supplies arrived three days later by plane. Within two weeks, over 1 million food packs and 250 000 litres of water was distributed.
- The government imposed a curfew two days after the typhoon to reduce looting.

Long-term Responses

- Thirty-three countries and international organisations pledged help. More than $1.5billion US dollars was pledged in foreign aid.
- A ‘cash for work’ programme paid people to clear up the debris and rebuild the city.
- Oxfam replaced many fishing boats.
- Mangroves were replanted.
- A new storm surge warning system was installed.
- More cyclone shelters were built.

<table>
<tr>
<td>Reducing the effects of tropical storms</td>
<td>
Monitoring

Satellites monitor cloud patterns
The Global Precipitation Measurement satellite monitors high altitude rain clouds every 3 hours which indicates if a storm will intensify within 24hours
NASA monitors weather patterns across the Atlantic using 2 unmanned Global Hawk drones.

Prediction

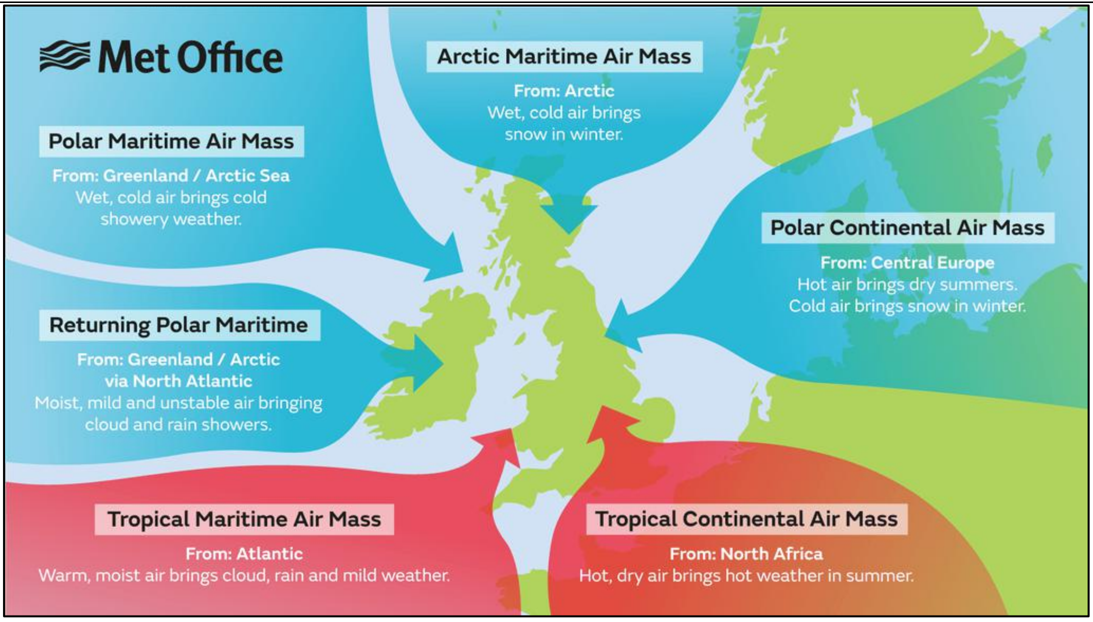
Supercomputers give 5 days warning and predict locations within 400km
Track forecast cones plot the storm’s predicted path.
Early warnings are issued by national hurricane centres around the world

Protection

Reinforce buildings to prevent damage
Build coastal defences
Create “no-build zones” in low lying areas.

Planning

Prepare disaster supply kits
ensure vehicles are fuelled
plan escape route to evacuation shelters

</td>
</tr>
<tr>
<td>Weather hazards in the UK</td>
<td>


The UK’s weather is influenced by a number of different air masses. These can trigger extreme weather events:

Storm Events: these come from the Tropical Maritime Air Mass as depressions (low-pressure systems) which bring heavy rain and winds.
Impacts: floods, wind damage to property, trees uprooted, power supplies cut, disruption to transport, death.
e.g. Autumn 2013

Flooding: Usually from the Tropical Maritime Air Mass, floods are caused by heavy rain or storm waves. Torrential rainstorms or thunderstorms can also cause flash flooding.
Impacts: crops ruined, damage to homes, transport disrupted, death by drowning, landslides.
e.g. Boscastle, 2004

Droughts and heatwaves: Usually from Tropical and Polar Continental Air Masses, bringing periods of little or no rainfall. In the UK a drought is defined as 15 or more consecutive days with less than 0.2mm of rain on any one day.
Impacts: crop production fails, wildlife affected, reservoirs run low, hosepipe bans, elderly and young vulnerable to heat exhaustion and death, roads melt and railways lines buckle BUT tourism is boosted.
e.g. summer of 2003
</td>
</tr>
</table>

Extremes of cold weather: Cold conditions from Arctic and Polar Maritime Air Masses take over if depressions are not over the country.
Impacts: crops fail and cattle may die at -10°C and below, roads, railways, airports close, increase in injuries, schools (yay!) and businesses shut.
e.g. Winter 2014-2015

CASE STUDY UK weather hazard

<u>Somerset Levels Floods, Dec 2013 – Jan 2014</u>

Cause
Several depressions (low air pressure systems) moving across the Atlantic Ocean caused weeks of wet weather. These systems were picked up by the Polar Jet Stream which was situated more south than usual and directed towards the west of England. It was the wettest January on record and heavy precipitation saturated soils. High tides and storm surges came up the rivers from Bristol Channel. Rivers were not dredged fir over twenty years which meant that sediment had built up on the river bed. This caused a reduction in the capacity of water the rivers could hold. As a result, they burst their banks.

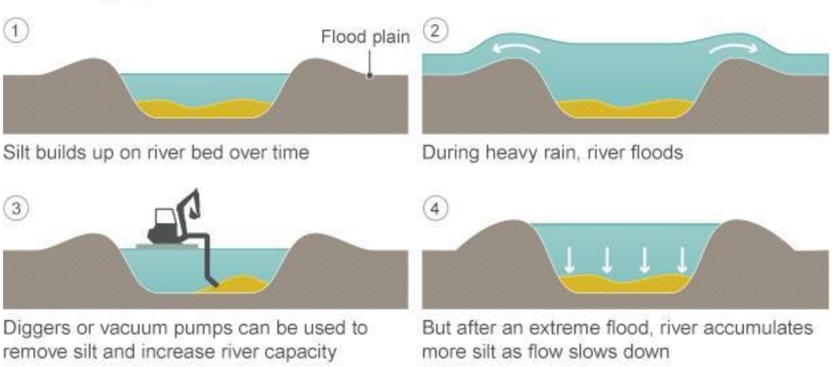
Social Impacts
- More than 600 homes were flooded.
- Sixteen farms were evacuated.
- Temporary accommodation for residents was needed for several months.
- Some villages were cut off.
- Power supplies were disrupted.

Economic Impacts
- Over 14 000 hectares of agriculture land flooded for weeks.
- Over 1 000 livestock were evacuated.
- Roads were cut off.
- Railway lines were closed.
- £10 million damage cost.

Environmental Impacts
- Rivers were contaminated with sewage, oils and chemicals.
- Debris was deposited across the land.
- Stagnant water had to be re-oxygenated and pumped back into rivers.

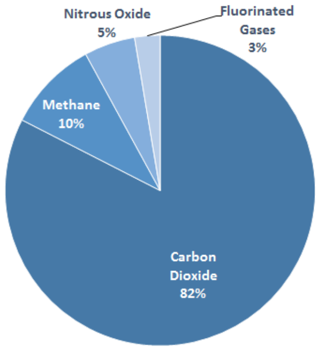
Management Strategies to Reduce Risk
- River banks were raised and strengthened.
- Somerset County Council pledged £20 million on a Flood Action Plan.
- Rivers Tone and Parratt were dredged in March 2014.
- Road levels were raised.
- Flood defences for communities at risk.
- Pumping stations were built.
- By 2024, there is potential for a tidal barrage.

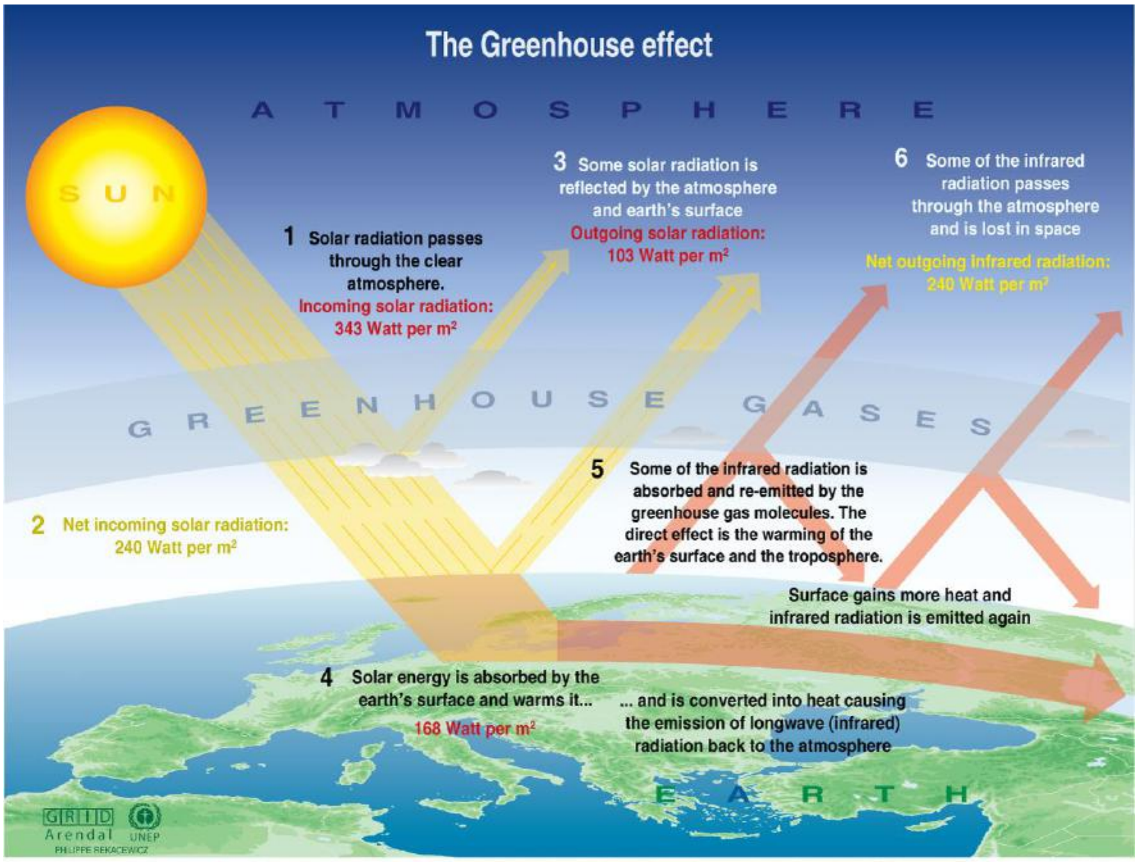
How dredging works



CLIMATE CHANGE

Key content		What you need to know
Evidence for climate change		Evidence of climate change occurring before humans existed means that throughout the history of the planet, natural climate change has occurred. However, natural causes cannot account for the steep rise in temperature since the 1970s. Greenhouse gases act as a blanket and ensure our planet is kept warm by the energy from the sun. The increase in concentration of these gases due to human activity, is preventing energy from the sun from escaping our atmosphere. This is causing global warming. This diagram shows the gases that make up greenhouse gases.



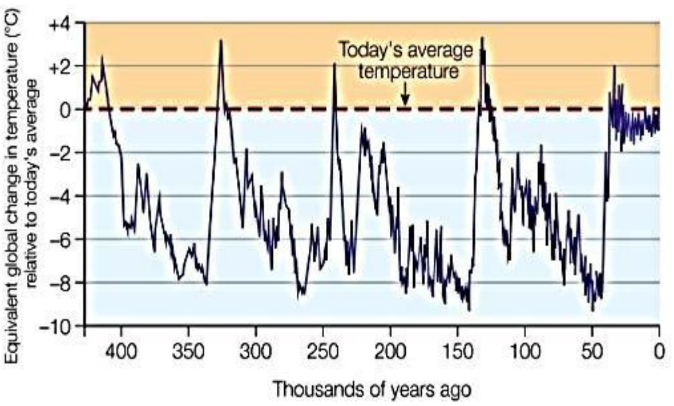


Sources: Okanagan university college in Canada, Department of geography, University of Oxford, school of geography; United States Environmental Protection Agency (EPA), Washington; Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1996.

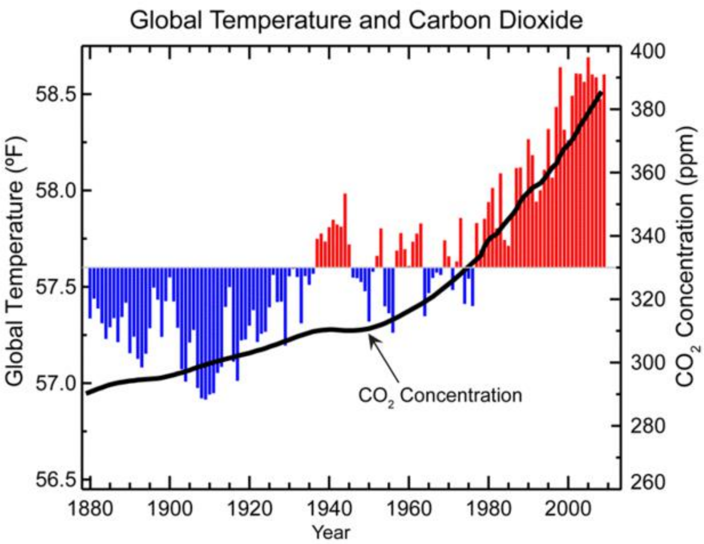
The MET office has recorded climate data consistently since 1914. This information shows:

- Increase in average surface air temperature by 1°C over the last 100 years
- The warmest ocean temperatures since 1850
- A 19cm rise in sea levels since 1900

Using information recorded in **tree rings, ice cores and ocean sediments** from the Quaternary Period, levels of oxygen and carbon dioxide combined with growth rates of trees enable scientists to calculate the climate of the Earth millions of years into the past. Diaries and paintings also tell us how climate has changed in more recent centuries.



Natural climate change accounts for over twenty cycles of **glacial periods (100,000 years long)** and warmer **interglacial periods (about 10,000 years long).** We are currently in an interglacial period and it has already lasted 15,000 years.



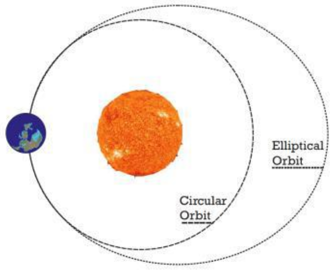
Human activity has seen temperatures rise steeply in the last 30 years. This graph shows the correlation between temperature rise and CO_2 concentrations in our atmosphere linked to the burning of fossil fuels.

Causes of climate change

NATURAL FACTORS

Orbital Changes:

Solar energy changes because the Earth's orbit around the sun changes from elliptical to round. During the elliptical phases the Earth is sometimes much closer to the sun and at other times, much further away. The Earth's axis also changes and this tilt can change the amount of energy it receives from the sun.



Solar Output:

Sunspots increase and decrease every 11 years. There were fewer sunspots during the "Little Ice Age" (1645-1715). However, solar output has not changed much in the last 50 years.

Volcanic Activity:

Volcanic aerosols reflect sunlight away which temporarily reduce global temperatures. Conversely, volcanoes can also be responsible for adding greenhouse gases to the atmosphere. 100-300 million tonnes of CO2 are released each year by volcanic activity but this is only 1% of the amount released by humans burning fossil fuels in that same time frame.

HUMAN FACTORS

Fossil fuels:

Burning fossil fuels releases CO2. This includes oil, coal and natural gas.
This accounts for **50%** of Greenhouse Gases.

Agriculture:

Growing populations and demand for meat and rice result in green house emissions. Methane is more potent than CO2 as a greenhouse gas.
This accounts for **20%** of greenhouse gases.

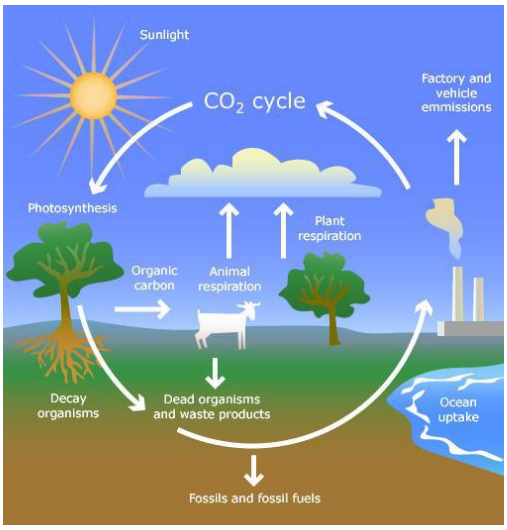
Deforestation:

Logging, clearing and burning land for agriculture increase the amount of CO2 in the atmosphere. This is because photosynthesis is reduced.
Forests cover approx. 31% of the Earth's surface but is losing 18.7 million acres of forests annually (or 27 soccer fields every minute).

Photosynthesis

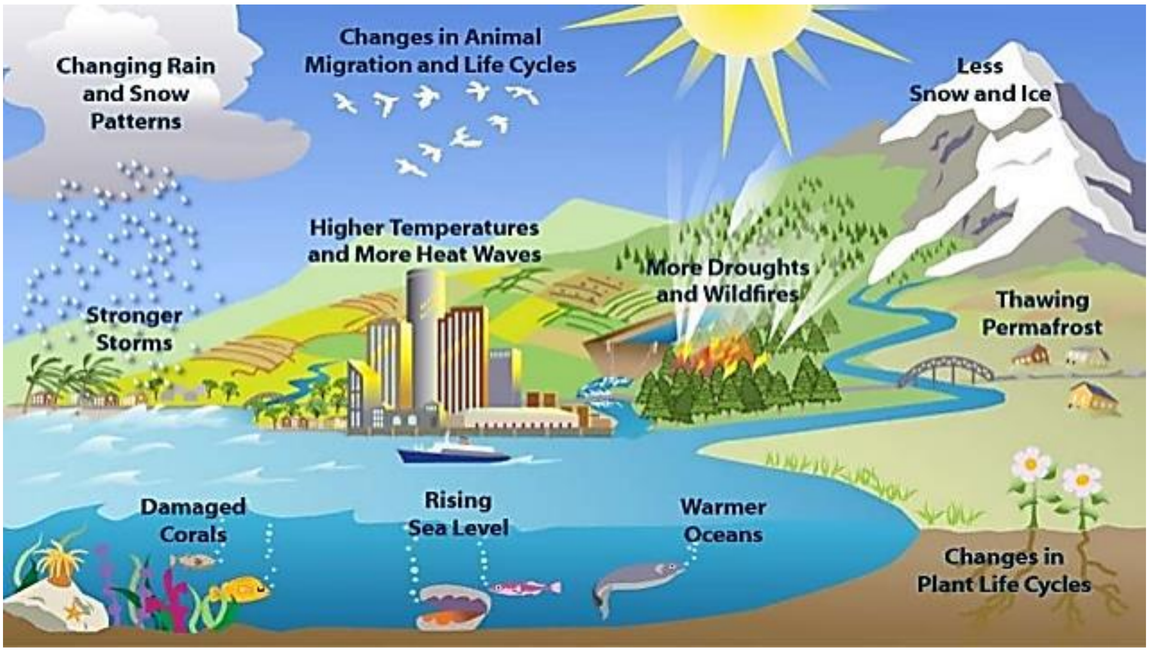
$$6CO_2 + 6H_2O \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} C_6H_{12}O_6 + 6O_2$$

$$\text{Carbon Dioxide} + \text{Water} \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} \text{Glucose} + \text{Oxygen}$$



This simplified **Carbon Cycle** shows how CO2 is naturally cycled through our atmosphere, biosphere, lithosphere and oceans. When it is interfered with through burning of fossil fuels, that balance is lost.

Effects of climate change



Understanding all the many challenges climate change presents us with is important but you also need to be able to give specific examples in different regions of the planet:

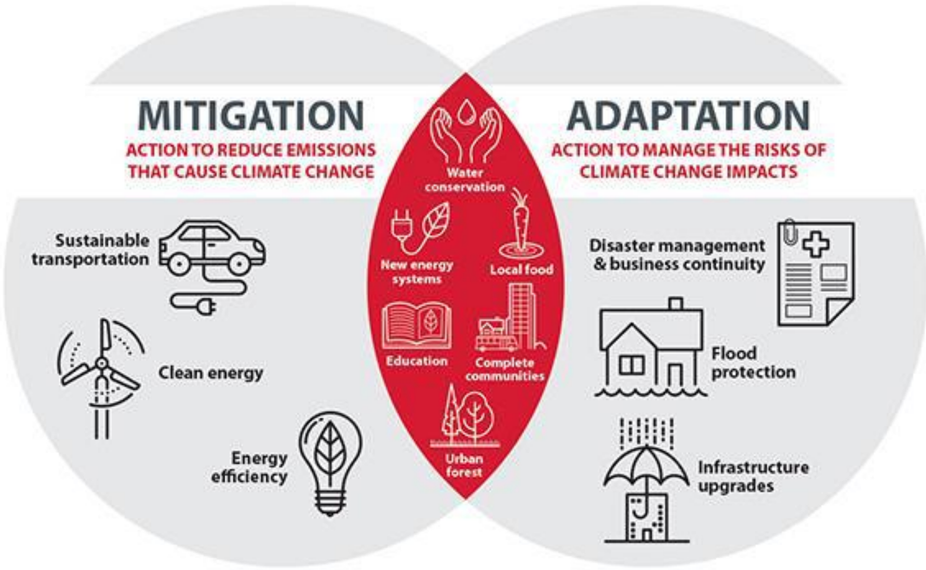
SOCIAL EFFECTS

- Increased risk of disease such as skin cancer, heat stroke, winter related deaths due to milder winters.
- Crop yields fluctuate due to droughts, flooding and storms. Maize will decrease by 12% in South America but increase in Europe.
- Less ice in the Arctic Ocean will increase shipping and extraction of oil
- Flood risks from increased storms and rising sea levels will increase migration away from flood prone cities and land such as Jakarta, Bangladesh.
- Flooding increases repair and insurance costs.
- Drought reduces water supplies in Sub-Saharan Africa and even the South East of the UK experiences water stress.
- More money is invested in prediction, protection and planning for climate change
- The skiing industry may decline due to reduced snowfalls in Alpine regions
- Civil unrest caused by droughts and famine (e.g. Syria)

ENVIRONMENTAL EFFECTS

- Lower rainfall causes food shortages for orangutans in Borneo and Indonesia
- Sea-level rise increases flooding and coastal erosion.
- Ice melts causing wildlife to decline e.g. polar bears in the Arctic and Adelie Penguins in the Antarctic.
- Warmer rivers change the ecosystem in the Ganges, causing food shortages for river dolphins.
- Increase in forest growth in Northern Europe as conditions become milder
- Increase in forest fires (e.g. California and Australia)
- Increase in bark beetle and other pests that destroy trees
- Coral bleaching and decline in biodiversity in the Great Barrier Reef.

Managing climate change – mitigation and adaption

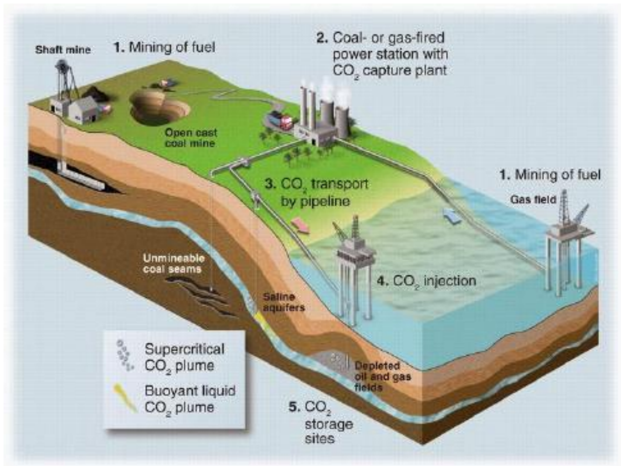


These two terms are key in understanding our approach to the threat of climate change. Mitigation was the main approach for some years and includes strategies such as making the switch to renewable energy but in more recent years, as climate change is already starting to affect us, adapting to those changes is also necessary. In the UK, this includes responding to increased flooding.

<u>**MITIGATION**</u>

Alternative Energy Production:
Wind, solar, geothermal, wave, HEP, tidal energy and biomass reduce greenhouse emissions but can have other disadvantages. For example, manufacturing the concrete needed for Hydro-electric dams produces vast amounts of greenhouse gases. Wind and solar are limited by the availability of wind and sun! There are still some issues of storing electricity but innovations in battery technology is fast creating solutions and the cost of this technology is becoming cheaper all the time.

Carbon Capture:
Carbon capture takes CO2 from emission sources and stores it under ground. It can capture 90% of CO2 and store it underground. It can provide 10-50% of the world's total carbon mitigation until 2100. However, many people believe that this strategy is flawed in that it encourages the continued use of fossil fuels, it is hugely expensive, it does not promote renewables and it is not certain that CO2 would remain underground in the long term so it may just delay the problem.



International Agreements:
International agreements encourage countries to take responsibility for reducing CO2 emissions. The Paris Agreement (2015) made it legally binding to meet targets and was signed by 175 countries. A recognition that LICs are going to be the hardest hit by climate change and that HICs are the most responsible for emissions means that financial support needs to be a part of the solution.

Planting Trees:
Planting trees is a really cheap and simple solution to capturing CO_2 as they absorb it through photosynthesis. Afforestation could increase storage by 28%. Other benefits include the oxygen and habitats but the decision to plant tress instead of for agriculture may put pressure on land use.
Ethiopia planted 350 million trees in one day in 2019

ADAPTATION

Changes in Agricultural Systems:
Changes are needed in response to changing rainfall and temperature patterns, weather becoming more extreme and increases in pests and diseases. Production may need to move to other areas and irrigation of crops may be needed.

Managing Water Supplies:
Managing water supplies ensures populations can face the challenge of changing rainfall patterns. In London, this involves reducing demand and increasing supply. Becton Desalination Plant opened in 2010 and supplies drinking water to North East London. Water meters and low flush / low flow devices can be fitted to loos and showers. Areas of water deficit may be at risk of political instability if the management of water is seen to fail.

Reducing Risk:
Reducing risk from rising sea levels could involve sea defences (Thames Barrier, restoring Mangrove forests). Raising properties on stilts or relocating vulnerable communities. Most of the World's largest cities are coastal and therefore the challenging of protecting these populations and improving infrastructure is immense.