Hazardous Earth

Knowledge checklist

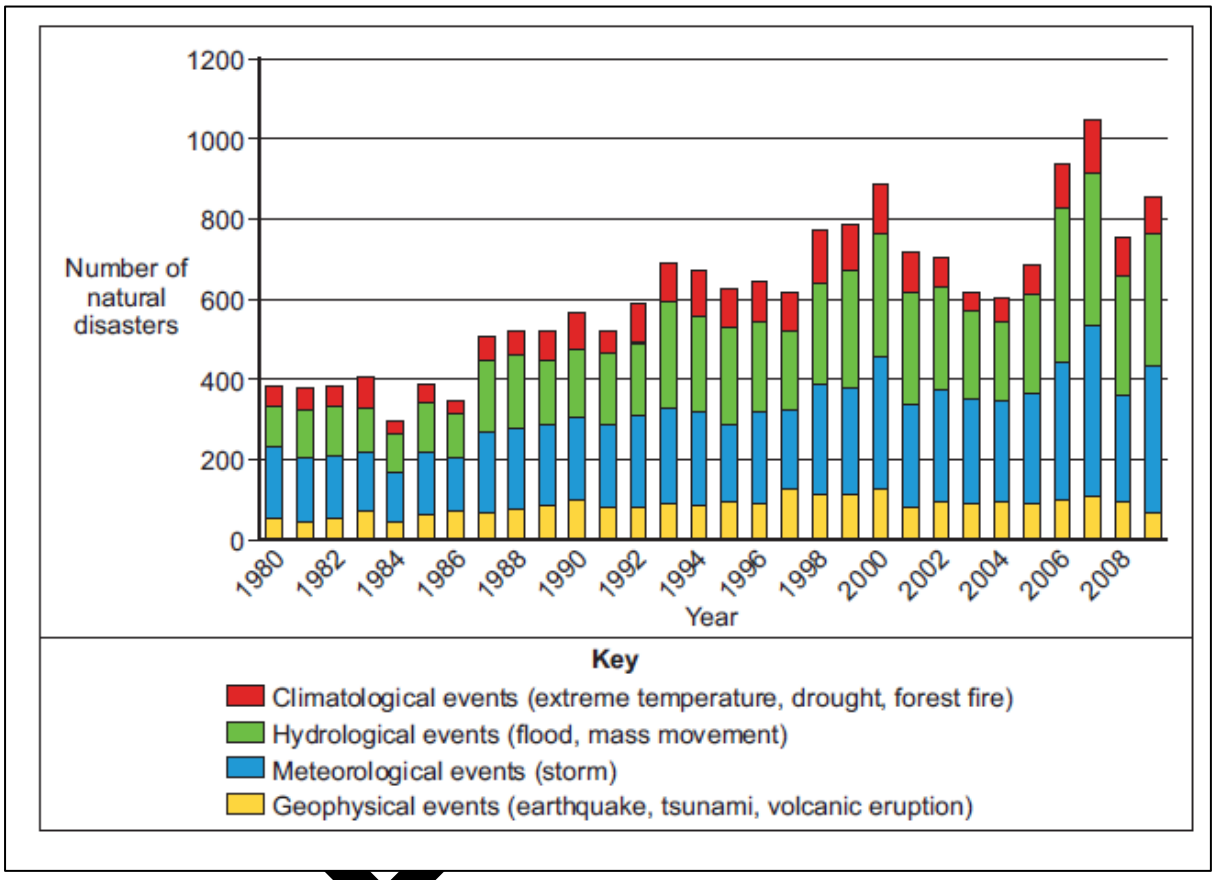
Key ideas	How secure is my knowledge?		
The atmosphere operates as a global system which transfers heat around the Earth - The global atmospheric circulation and how circulation cells and ocean currents transfer and redistribute heat energy around the Earth - How global atmospheric circulation determines the location of arid and high rainfall areas			
Climate has changed in the past through natural causes on timescales ranging from hundreds to millions of years and is now heavily influenced by human activity leading to an uncertain future - The natural causes of climate change and how they explain past climate change events - Evidence for natural climate change and how it is used to reconstruct glacial and interglacial climates during the Quaternary and UK climate - How human activities produce greenhouse gases that cause the enhanced greenhouse effect leading to global warming - Evidence for how human activity is causing climate change and possible consequences on people - The range of projections for global temperature change and sea level rise in the future including physical process and human reasons for uncertainty about those projections			
Tropical cyclones are caused by particular meteorological conditions and are a major hazard to people and places. Some places can respond and prepare better than others - Characteristics (pressure, rotation, structure) and seasonal global distribution of tropical cyclones including source areas and tracks and how these change over time - How the global circulation of the atmosphere leads to tropical cyclones in source areas, reasons why some tropical cyclones intensify and their dissipation - Physical hazards of tropical cyclones and their impact on people and environments - Why some countries are more vulnerable than others to the impacts of tropical cyclones			

- How countries can prepare for, and respond to, tropical cyclones - The effectiveness of these methods of preparation and response in one developed country and in one developing or emerging country			
Earth's layered structure, and physical properties is key to plate tectonics. Plates have different characteristics leading to earthquakes and volcanoes. Different places deal with these hazards in different ways - Earth's layered structure - How the core's internal heat source generates convection, the key foundation for plate motion - Distribution and characteristics of the three plate boundary types - Causes of contrasting volcanic and earthquake hazards - Primary and secondary impacts of earthquakes or volcanoes on property and people in a developed and emerging or developing country - Management of volcanic or earthquake hazards in a developed and emerging or developing			

Section 1

Atmosphere and Climate

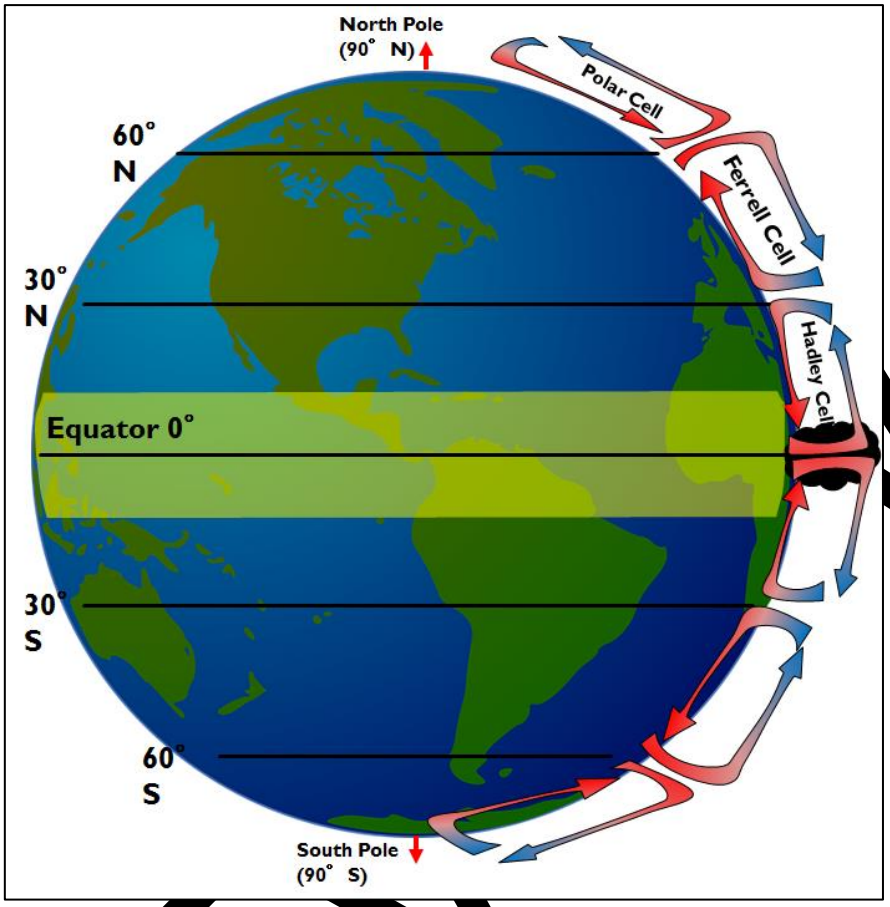
Are natural hazards becoming more common?



What affects event

- Magnitude
- Frequency
- Other physical factors e.g. geology, coastal morphology etc.
- Population density
- Level of development
- Effectiveness of Management
- Time of event

Atmospheric Circulation



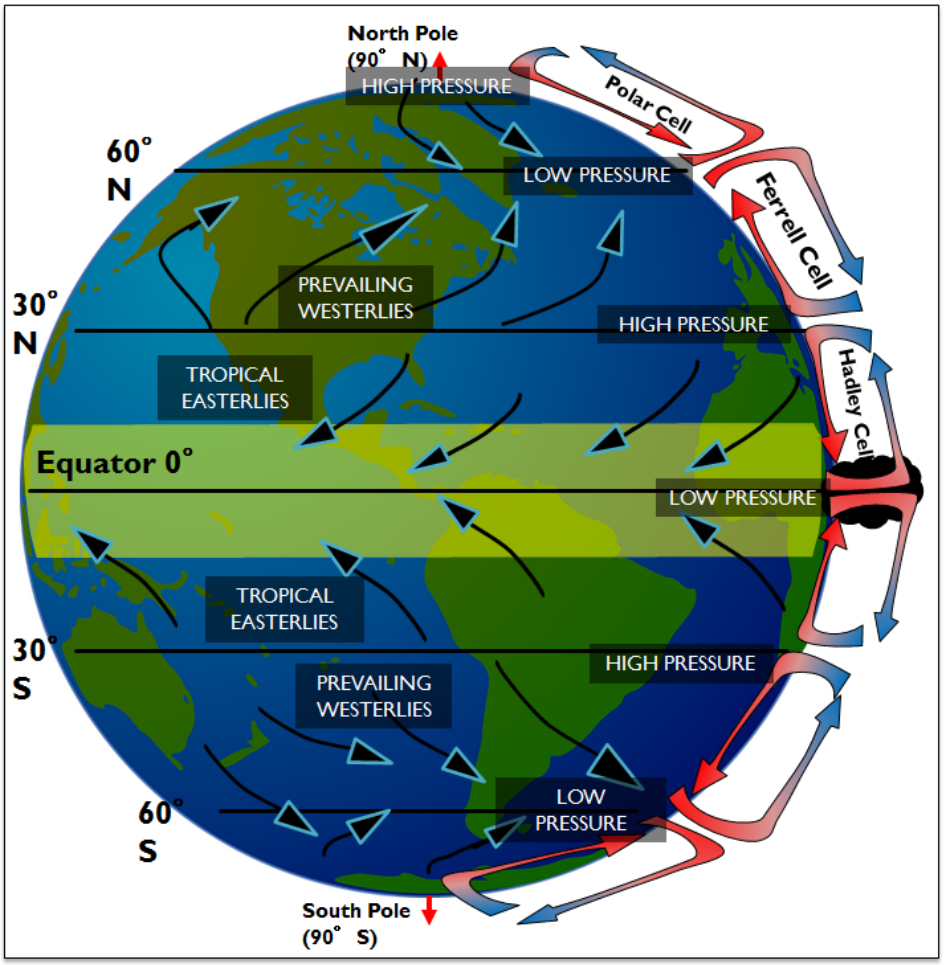
1
- Most insolation arrives between the two Tropics (Cancer and Capricorn). This causes air to rise from the surface up through the atmosphere in thermals at the Inter Tropical Convergence Zone (ITCZ).

2
- This creates large cumulonimbus clouds as the air cools, Tropical storms with low pressure occur in these areas

3
- As it heads North and South the air cools

4
- This air then sinks back down to the surface at approximately 30°N & S giving high pressure

5
- This goes back to the Equator as the trade winds. Two further cells exist further North and South.



The Coriolis Effect

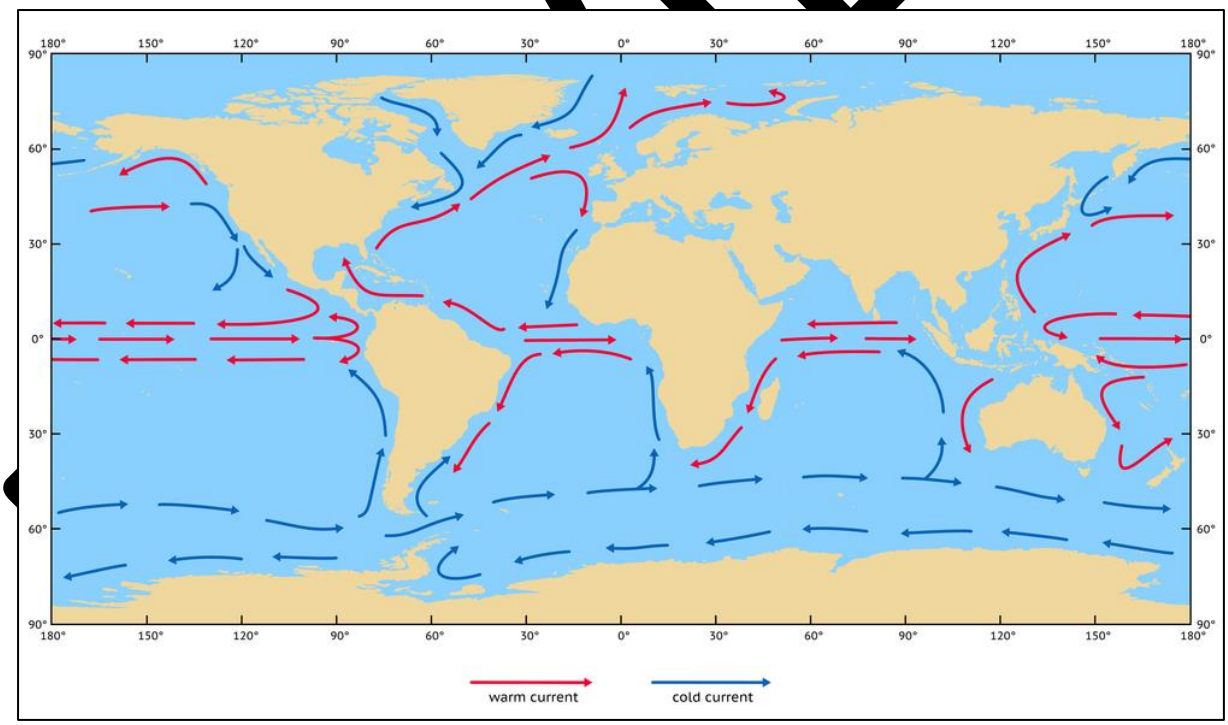
- The Coriolis effect cau deflection in global wind patterns.
- The ar ockwise otation o e E th deflects winds to the right in the northern hemispher nd ft in the southern hemisphere.

This is reaso hat storms like hurricanes appear to spin and why the winds on our i-cell r model do ot travel directly North or South.

Ocean C ents

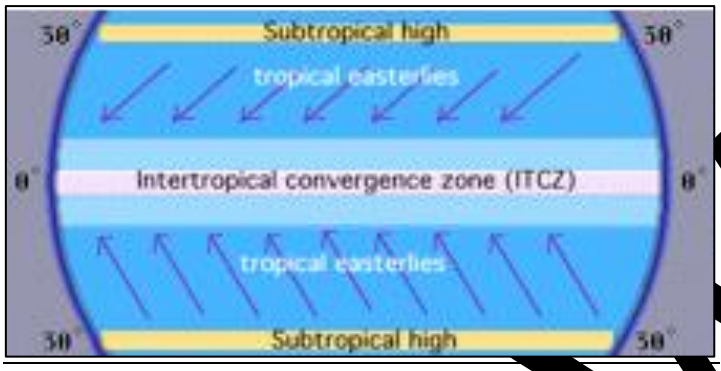
1. The **Gulf Stream** (and its extension, the **North Atlantic Drift**) bring warm, salty water to the NE Atlantic, warming western Europe.
2. The water cools, mixes with cold water coming from the Arctic Ocean, and becomes so dense that it sinks, both to the south and east of Greenland.
3. If we look at a map, we see that this current is part of a larger system, connecting the North Atlantic...

4. ...the tropical Atlantic...
5. ...the South Atlantic...
6. ...the Indian and Pacific Oceans...
7. ...and the Southern Ocean. Further sinking of dense water occurs near to Antarctica.
8. If we look below the surface, water from the two main sinking regions spreads out in the subsurface ocean...
9. ...affecting almost all the world's oceans at depths from 10[illegible] and belo[illegible]...
10. The cold, dense water gradually warms and returns to the sur[illegible]e, th[illegible]ugh[illegible]t the world's oceans.
11. The surface and subsurface currents, the [illegible]king regions, and the [illegible]n of water to the surface form a closed loop, the **thermo[illegible]ine [illegible]rculation** or **global thermohaline conveyor belt**.

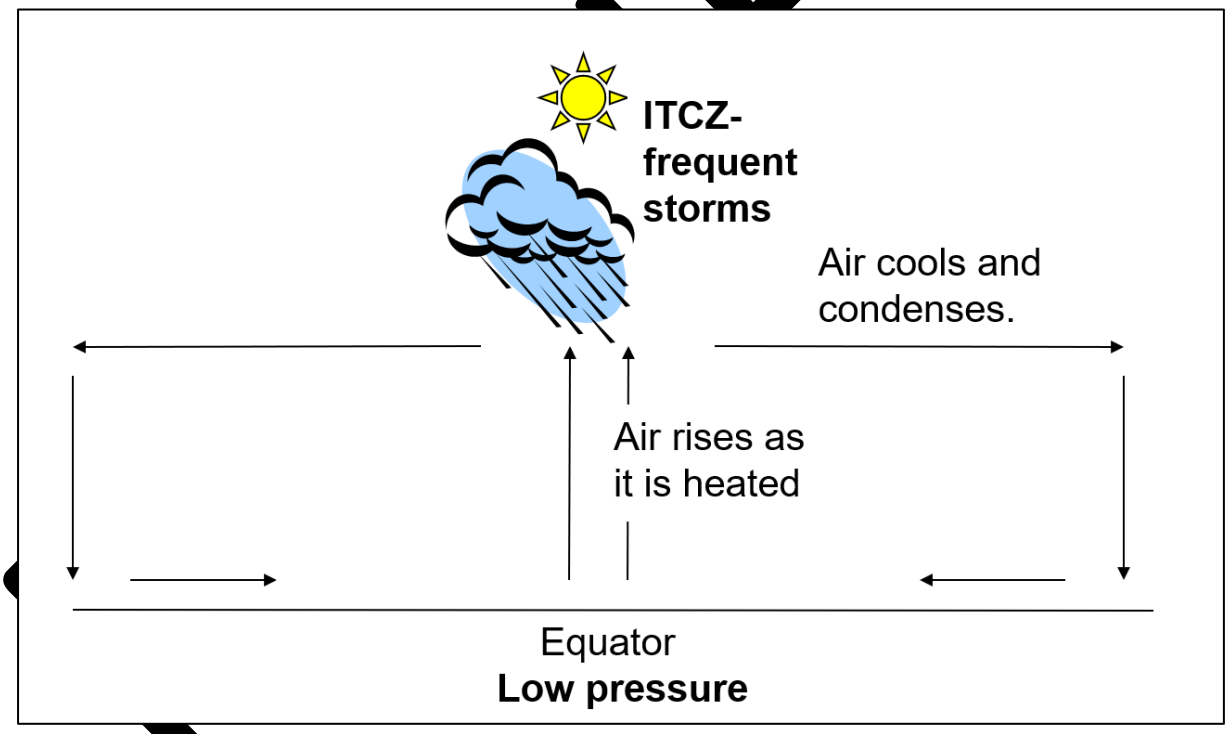


The ITCZ

- The ITCZ is where the North Easterly trade winds meet the South Easterly trade winds.



- The air at the equator is being heated by the overhead sun and therefore rises, the ITCZ can therefore also be described as a band of low pressure.

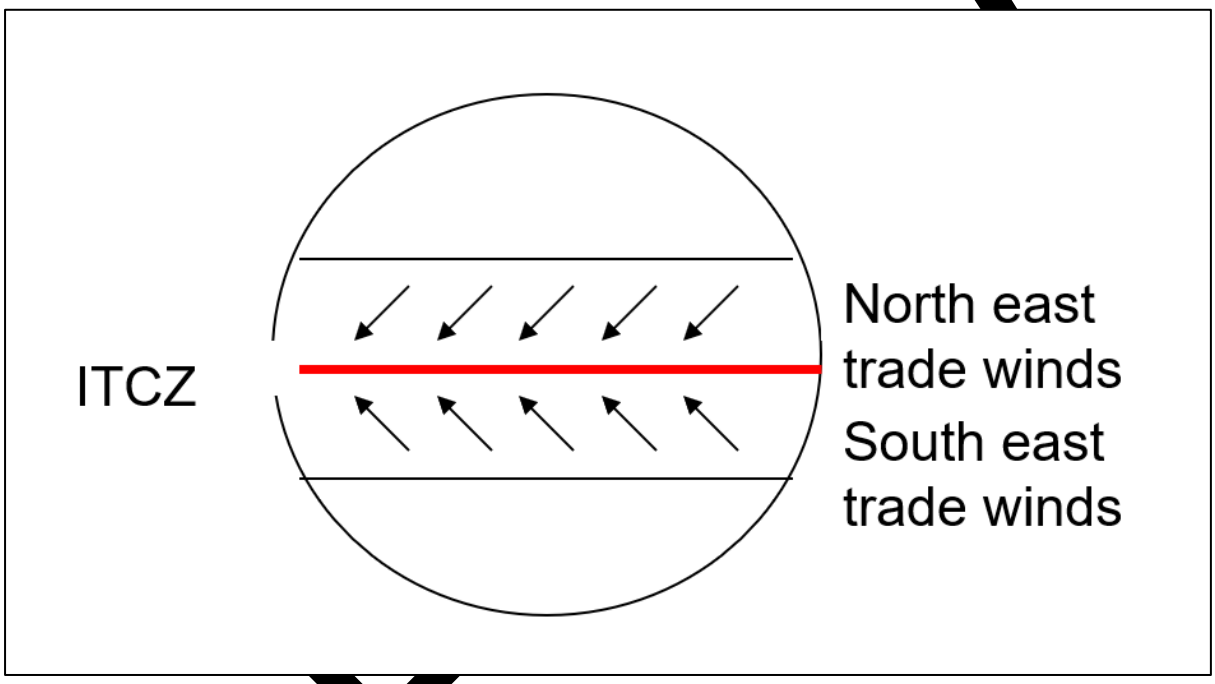


- We need to know how this band of heavy rain showers effects the west coast of Africa, as this is where the effects of the ITCZ are felt the most.
- It is commonly thought that the sun is overhead at the equator all year round, this however is not true. Due to the earth spinning on a tilted axis the position of the overhead sun migrates northwards, when we have our summer solstice (longest day) and then migrates southwards, our winter solstice (shortest day).

- This means the ITCZ is also going to travel north and south through out the year. This means the heavy rain showers on the West coast of Africa are very seasonal.

Air masses and the ITCZ

- As the ITCZ moves north with the position of the overhead sun it pulls the South east trade winds into the northern hemisphere. These winds then change direction due to the Coriolis force and loop round to become south westerlies.



- Now l[illegible]hese tr[illegible] winds ov[illegible] Africa.
- **The[illegible]rth e[illegible]t winds ar[illegible]alled Tropical Continental (cT).**

[illegible]e win[illegible]travel ove[illegible]and and are therfore dry.

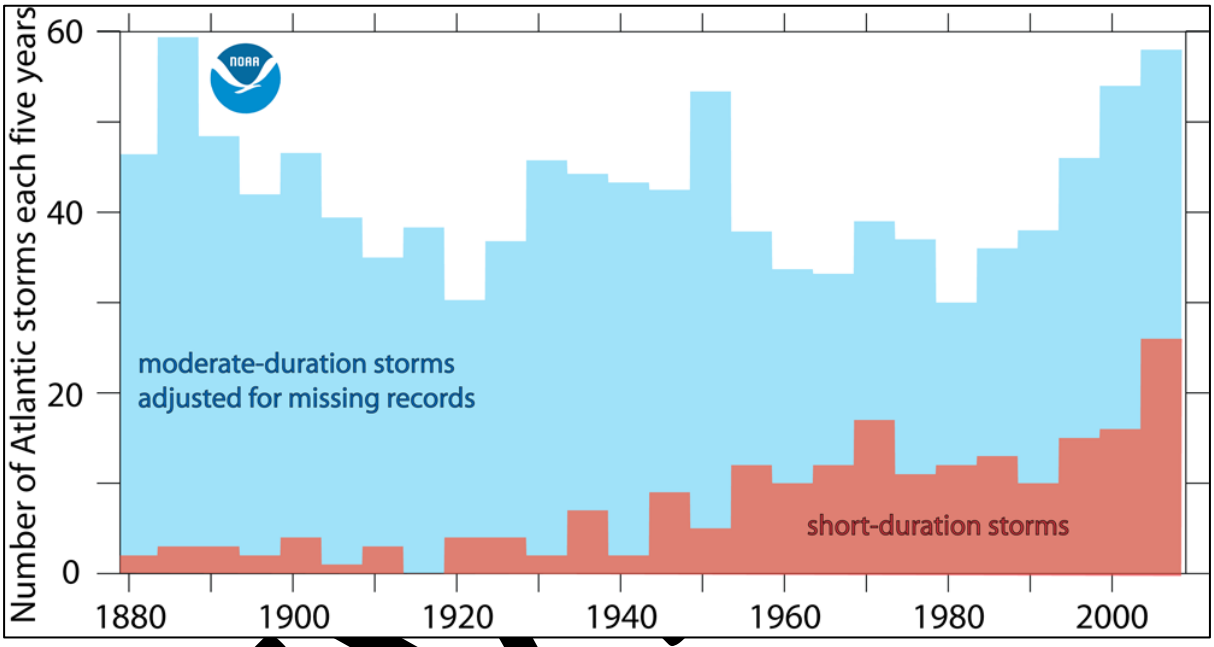
The[illegible]outh wes[illegible]winds are called Tropical Maritime (mT).

- [illegible]se winds have travelled over the Atlantic Ocean and are therefore wet.
- As the ITCZ moves north it will pull the mT winds over the land. This will bring wet weather to any places which lie south of the ITCZ. At the same time places to the north of the ITCZ will be experiencing hot dry weather.
- To summarise:
- Directly underneath the ITCZ = convectional thunderstorms.

- South of the ITCZ = wet Weather from mT.
- North of the ITCZ = dry weather from cT.

Climate change causes

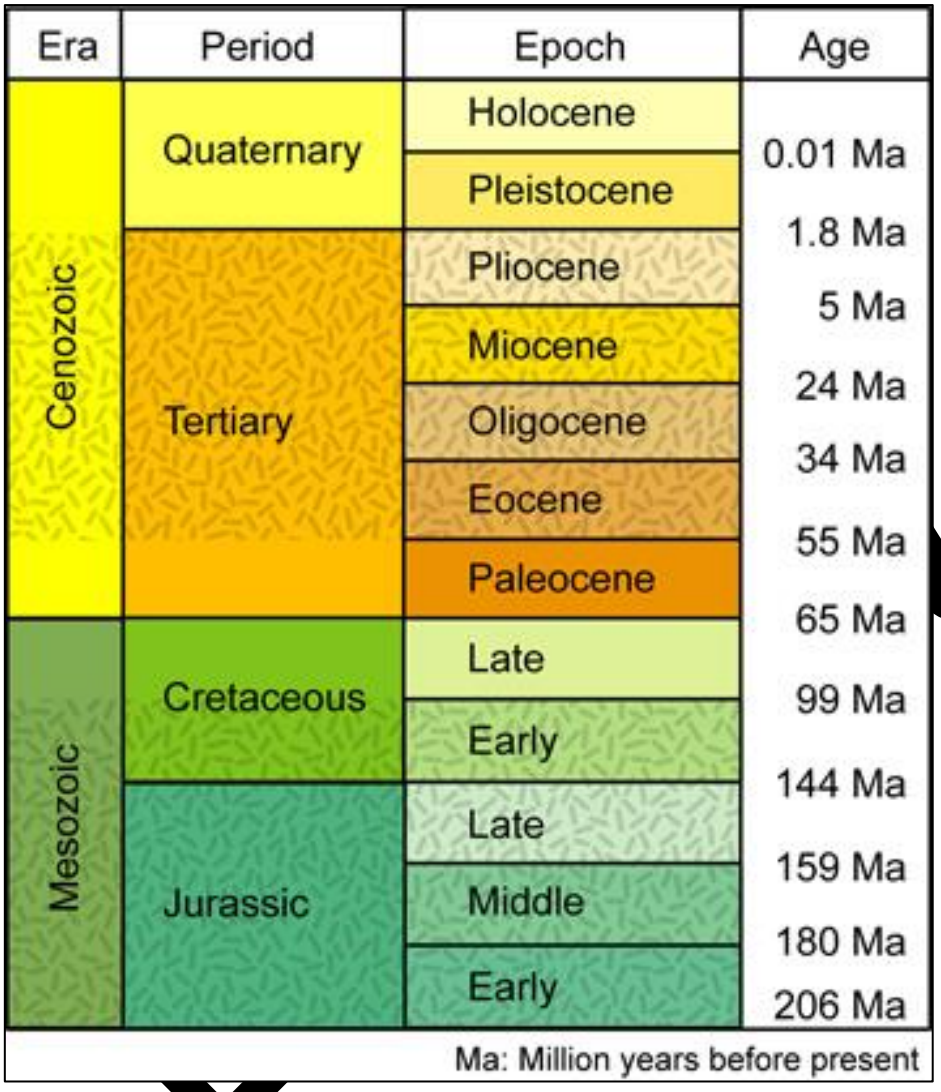
Climate change and tropical storms



Climate change

Human and natural reaso[illegible] for [illegible]ange

- Clim[illegible]e chang[illegible] – the la[illegible]-scale [illegible]g-term shift in the planet's weather patterns or averag[illegible] temp[illegible]tures. Earth[illegible]s had tropical climates and ice ages many times in its [illegible] billion[illegible]ars. (Met[illegible]ce)
- Glob[illegible] warming[illegible] A gradual increase in the overall temperature of the earth's [illegible]osphere generally attributed to the greenhouse effect caused by increased levels of [illegible]rbon dioxide, CFCs, and other pollutants. (Oxford dictionaries)
- Quaternary period – the current geological period dating from 2.6million years ago to the present day. We live in the Holocene epoch of the Quaternary period, which covers the last 12,000 years since the end of the last ice age.



Evidence for climate change:

- Climate has always fluctuated – during the last Ice Age 10,000 years ago, average temperatures were 9°C cooler than present day.
- The climate began to warm after the Ice Age and this trend has continued – however there have been some variations.
- The 'Little Ice Age' occurred between the mid 1500s to around 1800. During this period the Thames froze regularly. Average sea surface temperatures in the Central Atlantic estimated at 1°C cooler than present average (radiocarbon sediment core).
- The 'Medieval Warm period between 800 and 1300 was 1°C warmer than today by the same measure. The Vikings used this warm period to settle the ice free shores of Greenland.

- The Holocene climatic optimum around 7500-5000 BP was a warm period – minor increases at the equator but up to 4°C average increase at the poles – this lead to the spread of vegetation across northern Europe.

The Greenhouse effect

- Carbon dioxide allows short wave solar radiation to pass and warm the Earth.
- This heat is radiated and reflected back by the Earth's surface as longer wave radiation which cannot pass as easily through the greenhouse gases in the troposphere.
- This is the Greenhouse effect and is a natural process that actually makes the Earth habitable. – we would be about 30°C colder without the effect
- Greenhouse gases are water vapour, carbon dioxide, CFCs, methane, nitrous oxide and ozone.

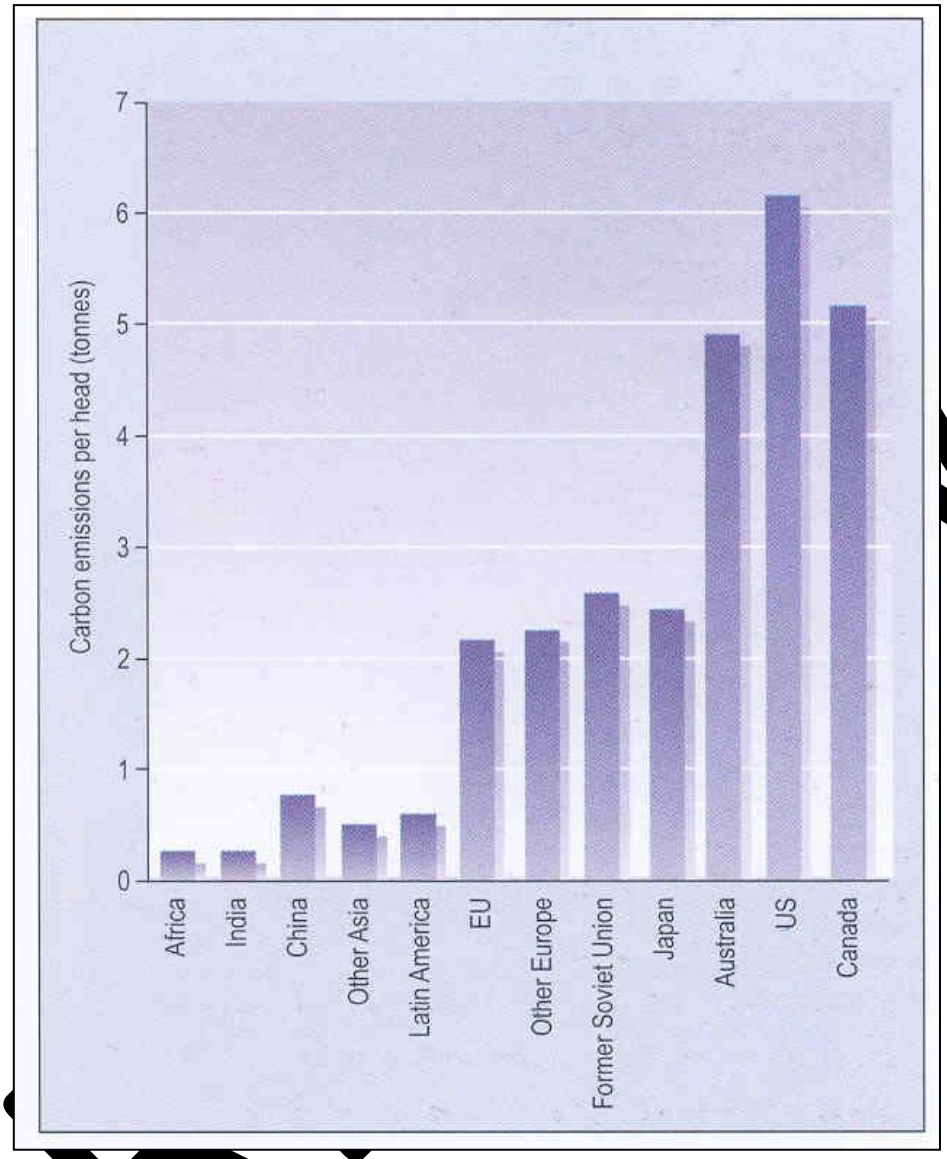
Human influenced greenhouse effect?

- As long as gas concentrations and solar activity remain constant then Earth's temp. remains stable.
- However CO_2 concentrations have increased by 15% in the last 100 years.
- Current rate of increase is at 0.4% per year despite international attempts to halt increases.
- This is alleged to have caused an increase in global temperature and hence 'global warming'.

Major causes of emissions

- Fossil fuel consumption – burning releases CO_2. The industrialised nations, especially the US have traditionally been worst culprits, however industrialisation of China and India is now a major issue as they fell outside of the Kyoto protocol.
- Deforestation – trees act as a carbon sink. Burning them to clear land releases CO_2 and further use of the land for cattle farming releases methane. Particularly a problem in Tropical rainforests.

Carbon emission per head



Other causes

The eruption theory

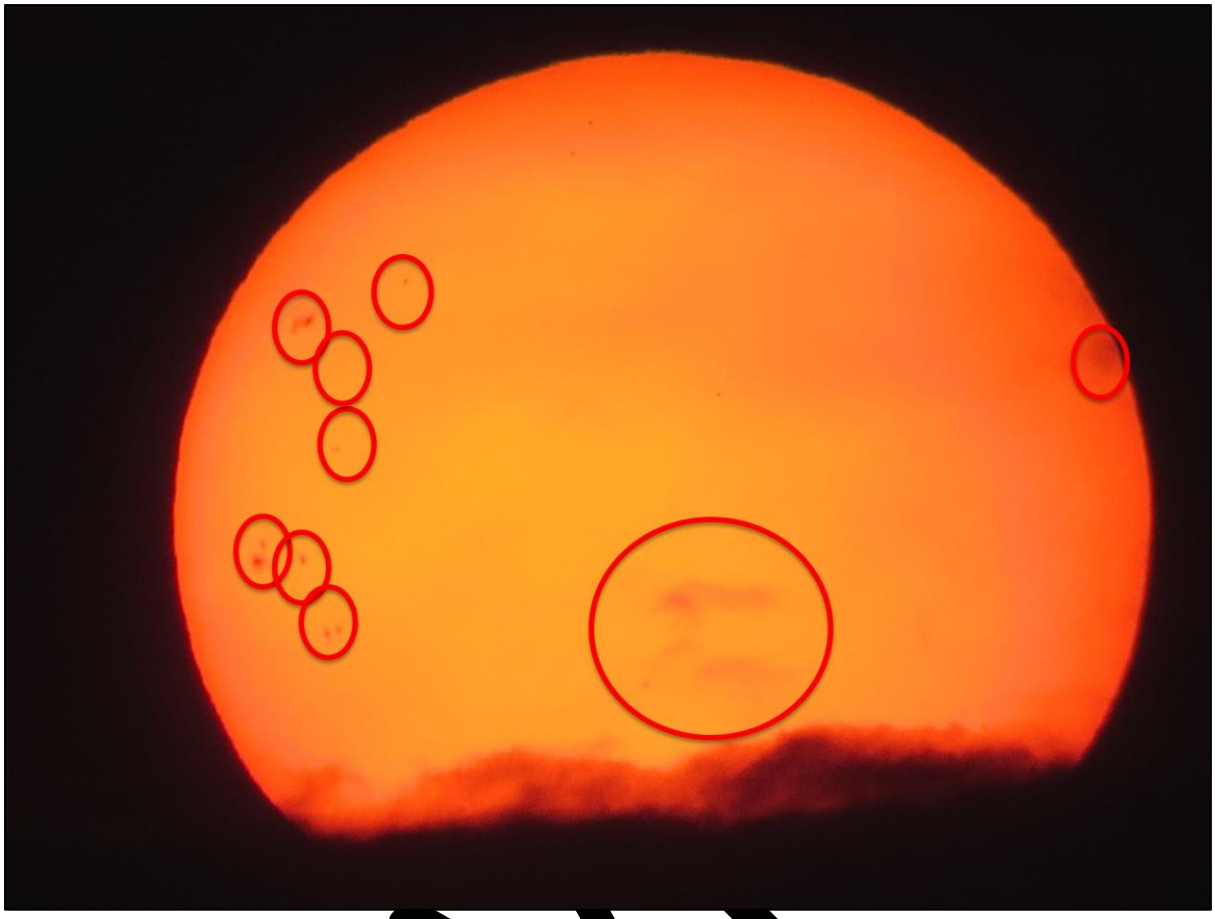
- Big volcanic eruptions can change the earth due to ash and sulphur dioxide gas.
- When released the can be spread around the world in the stratosphere.
- In 1991 Mt. Pinatube in the Philippines erupted and released 17 million tonnes of sulphur dioxide into the atmosphere. This cooled the earth by about 0.5°C for 1 year.

Asteroid collisions

- Asteroids colliding with the earth can change our climate
- In 1908 a asteroid 100m wide exploded above Russia
- It flattened 80 million trees
- This releases a large amount of dust and ash into the atmosphere
- This then cools the earth as it blocks out the sun

Sunspot theory

- 2000 years ago a Chinese astronomer started to r[illegible]d sunspo[illegible]
- These are black areas on the surface of the [illegible]
- They indicate how active the sun it.
- More spots means more energy[illegible]
- Many believe the Little Ice Age was [illegible]used by [illegible]is.



Orbital Theory

- Over long time scales their have been big changes in climate.
- Some scientist believe this is to do with how the earth orbits the sun.
- Sometimes the earths orbit is an ellipse.
- Other times it wobbles on its axis.

Mitigating Climate Change

- Alternative energy
- Carbon capture
- Plant trees
- International agreements

Past Climate

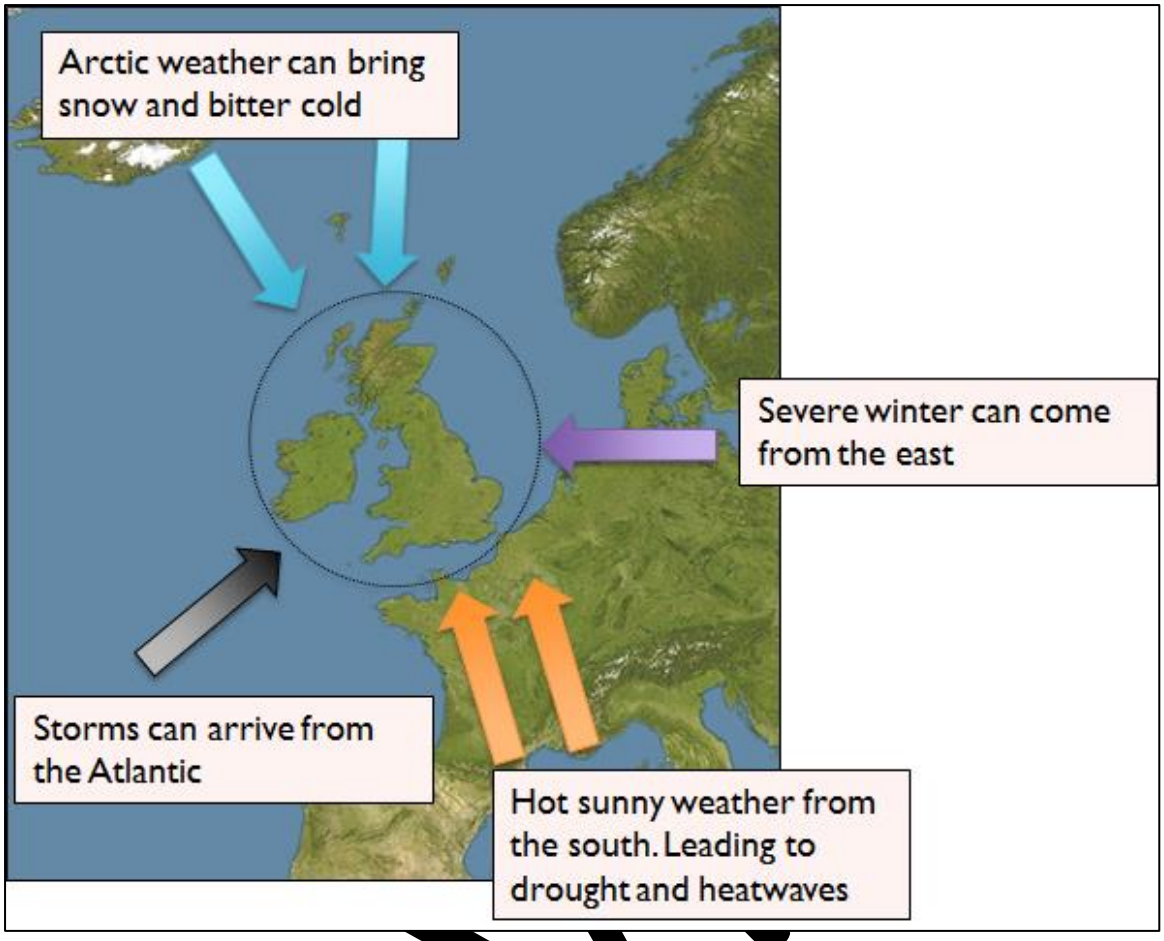
The distant past

- 120 000 years ago rhinos and elephants lived in what is now London. We know this due to the fossils that scientists have found.
- There was also a huge ice sheet stretching from the north pole to as far as London. We know this because of the landforms in the UK such as V shaped valleys.
- Ice Cores
- Tree rings - In temperate climates such as Western Europe trees grow every summer.
- Periods of growth can be seen in the rings of trees.
- Each ring is a year of growth.
- When the rings are close together it means the year was cold and dry, far apart warm and wet.
- Historical sources - Old photos, drawings and paintings, written records such as diaries and newspapers, harvest and flood records.

UK Weather

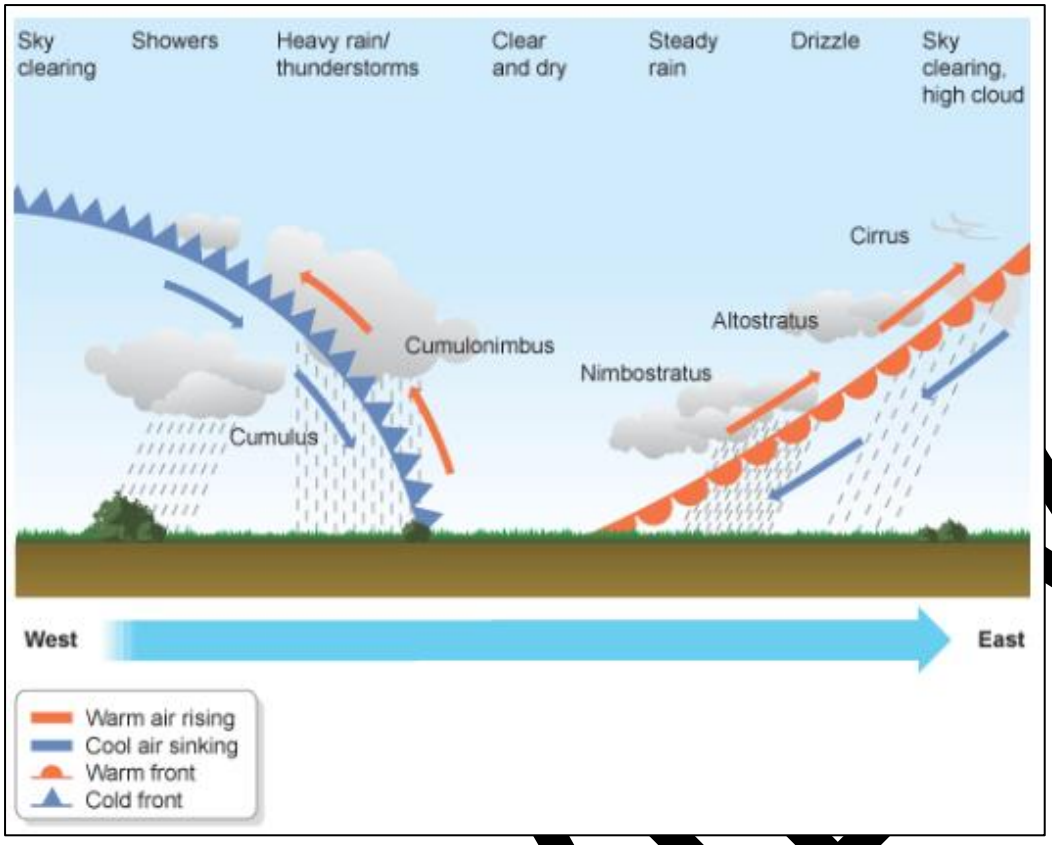
Why does extreme weather happen in the UK

- The UK is like a roundabout
- It is the meeting point of weather from several directions
- This explains why the weather is so changeable



Depressions

- Depressions are areas of low atmospheric pressure which produce cloudy, rainy and windy weather. These low-pressure systems often begin in the Atlantic, moving eastwards towards the UK. They are responsible for the UK's changeable weather.



Weather Depression

1

- Warm Tropical air migrates north from the Tropics, and meets cold polar air migrating south from the Arctic Regions over the Atlantic Ocean. They meet at a point called the Polar Front.

2

- Where these 2 air masses meet an embryo depression is formed

3

- The warm air is undercut by the advancing cold air at the fronts and because it has more energy and is less dense is forced to rise upwards at a COLD FRONT.

4

- Ahead of this, warm air advances into cold air and is also forced to rise above this denser cold air at a WARM FRONT. The air rises in a spiral motion, and this creates low pressure at the earth's surface at the center of the storm.

5

- At both fronts air is rising, so it cools down and creates water droplets (cloud formation) and eventually rain (once the droplets have collided enough to be big enough to fall) AT BOTH FRONTS.

6

- The cloud types at the 2 fronts are different however. Cirrus, cumulus and Nimbostratus are common on the warm front where warm air is slowly lifted over the cold air in front of it. This gives prolonged but lighter rainfall. Cumulonimbus and stratus clouds form at the trailing cold front, as the uplift of warm here is more rapid.

7

- Air rushes in from higher pressure areas around the depression giving the high winds we often associate with depressions.

8

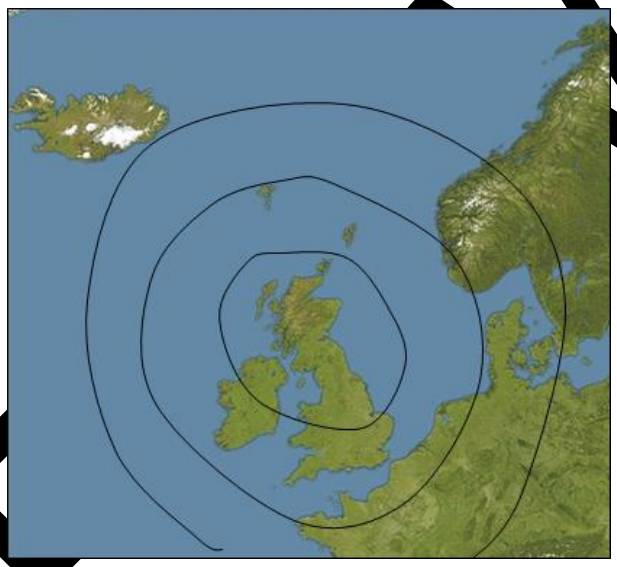
- The final stage of the depression life cycle model is where the cold front catches up with the warm front and an OCCLUDED FRONT is created.

Anticyclone

- A weather system with high barometric pressure at its centre, around which air slowly circulates in a clockwise (northern hemisphere) or anticlockwise (southern hemisphere) direction. Anticyclones are associated with calm, fine weather.

Anticyclones are the opposite of depressions - they are an area of high atmospheric pressure where the air is sinking.

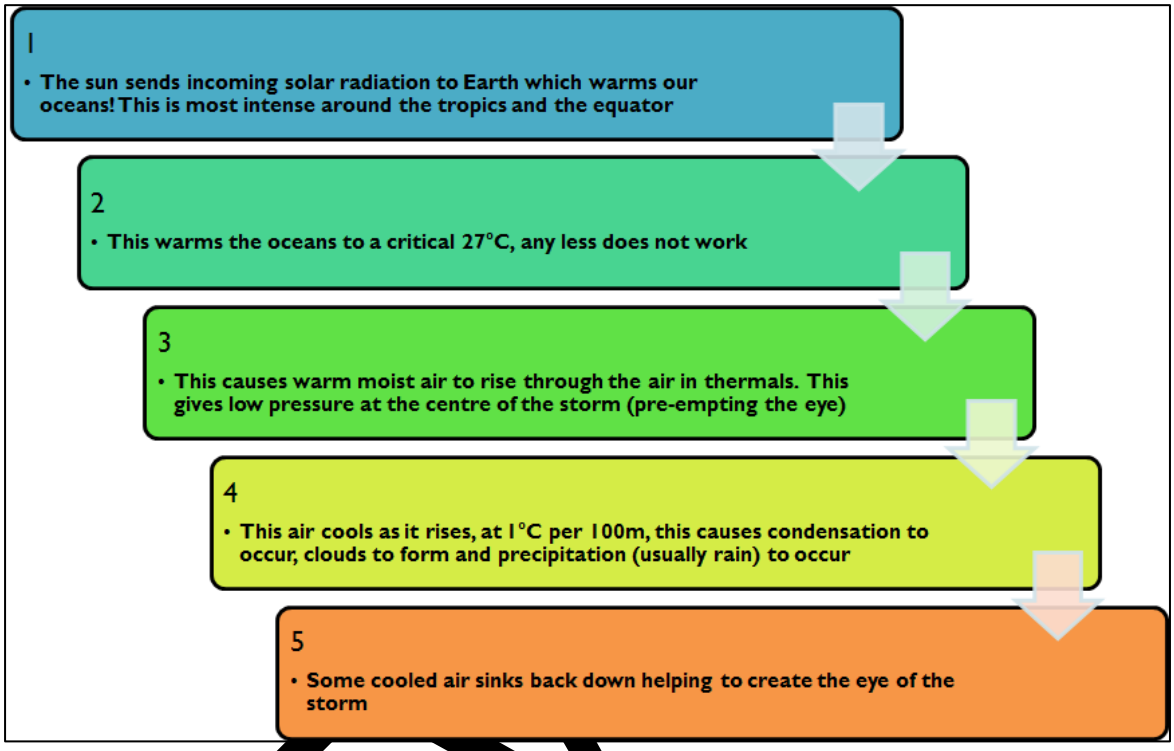
- In summer this makes hot dry weather.
- In winter this makes fog and mist due to the air condensing [illegible] altitud



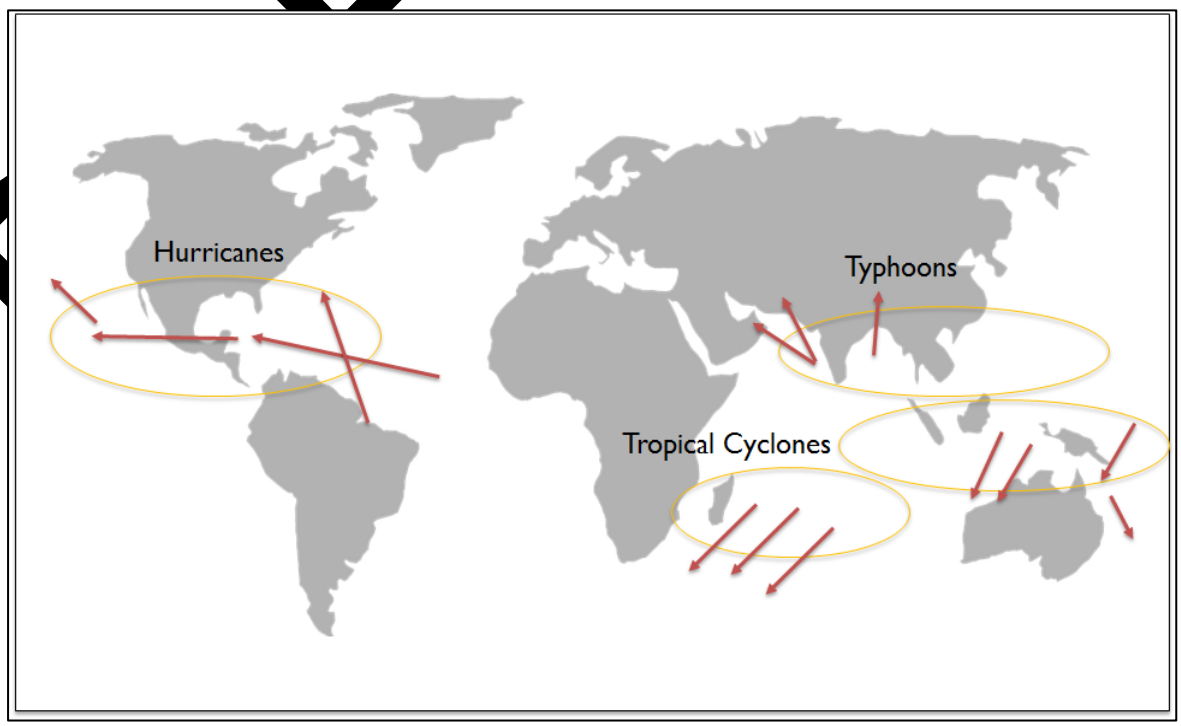
Section 2

Tropical Storms

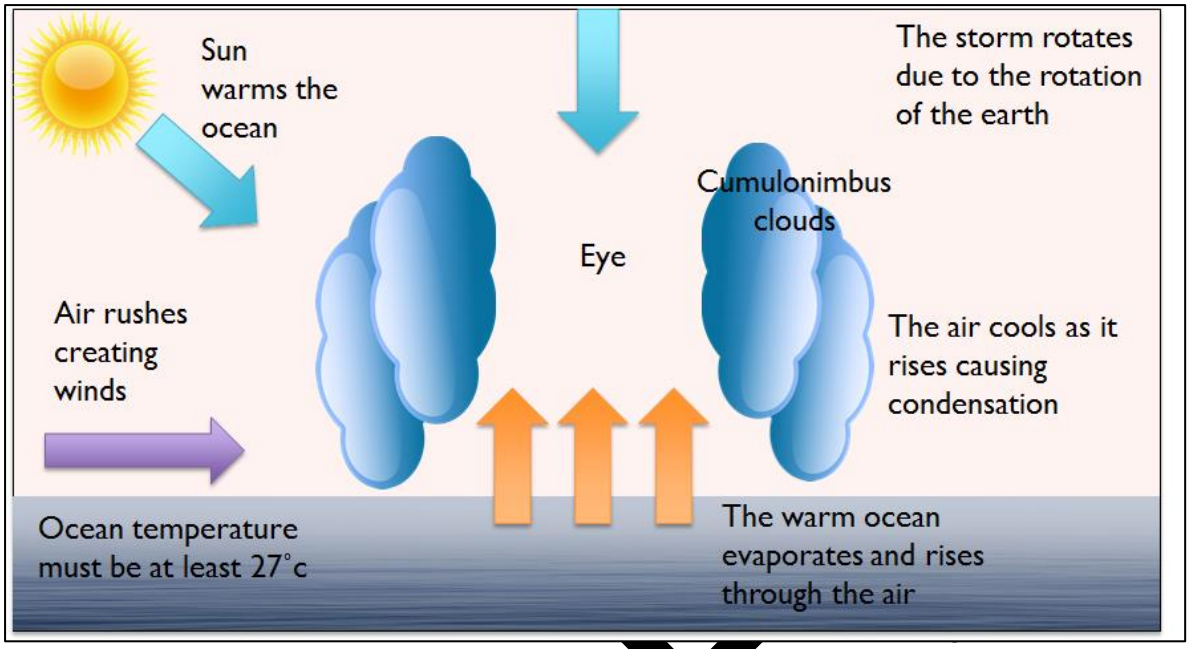
Formation of a tropical storm



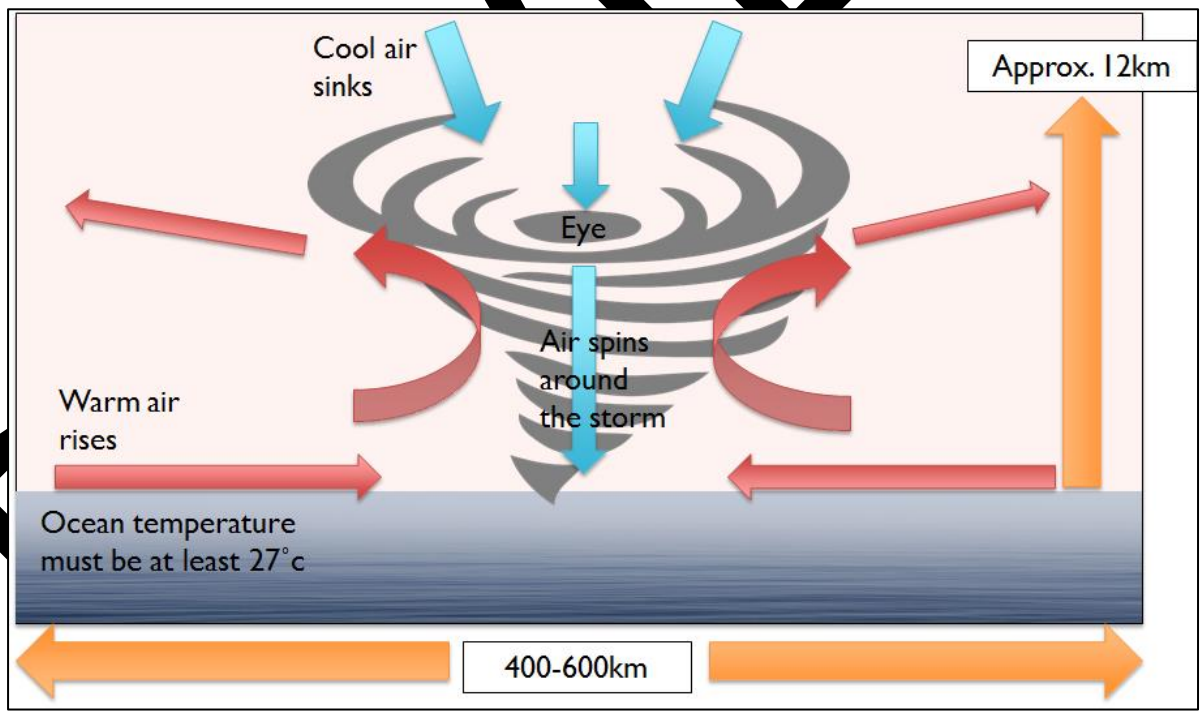
A map to show the global location of tropical storms



Hurricane Formation



Hurricane Cross Section



Hurricane Katrina

Around the 23rd August 2005 a small tropical depression formed over the warm waters of the coast of Florida; within a week it had deepened to form a Category 5 hurricane that destroyed the Louisiana city of New Orleans, killed over 1,700 people and caused in excess

of $100 billion in damages. It remains the most costly hurricane ever and took more lives than any USA storm since 1930.

As the name suggests, Katrina was the 11th tropical storm that ear; a year that produced record numbers of storms, hurricanes and in particular category 5 hurricanes.

Katrina's path took it over the southern tip of Florida but it was over the warm waters of the Gulf of Mexico that the storm deepened to exceed wind speeds of 282km/h, thereby creating a category 5 hurricane. Despite dropping to a category 3 event before reaching land over the delta of the Mississippi River, Katrina was a huge and powerful storm. The accompanying storm surge varied from 3 to 10 m in height and along with the powerful winds and intense rain, building damage and flooding was extensive.

People

An area the size of the UK was impacted by Hurricane Katrina's destruction. Within this it was the city of New Orleans in Louisiana that suffered most and hit the headlines. Built on the floodplain of the Mississippi River and being mostly below sea level, much of the city rapidly flooded when three protective levees along the river and lake gave away. Over one thousand of the city's 460,000 lost their lives, while the homes of most were destroyed or seriously damaged. Over half a million US citizens became refugees in their own country and half of these said they were unlikely to return to New Orleans as a result of their trauma. It was the poor, working class population, often without insurance, who lost the most in the storm. Katrina rewrote the population distribution map of the region; the state population fell by over a third while Louisiana areas outside New Orleans grew in numbers as the city people fled. In the coastal state if Mississippi 109,000 were made homeless and over 200 died. The FEMA helped 108,000 people with unemployment benefit.

Property

- Housing damage and destruction was widespread and stretched up to 100 km from the storm centre. At least 100,000 temporary homes were needed across the region.
- Services in New Orleans were severely damaged. Even six months after the event the city centre had no functioning sewage system, and gas and electricity supplies were not available.

- Agriculture suffered heavy losses including the death of nine million poultry in Mississippi, while in the same state the dairy industry lost $12 million.
- The forest industry in the region was affected; over one million acres of forest was destroyed. Due to Katrina, a total financial loss to the timber industry is estimated at $5 billion.
- The US Corps of Engineers, the group responsible for river management, estimated that in Louisiana there were over 70 million cubic metres of storm debris to be removed.
- In the aftermath of Katrina hundreds of thousands of local residents were left without work. This will have a trickle-down effect with lower income tax being paid to the US Government. It is estimated that Katrina's total economic impact in Louisiana and Mississippi will exceed $150 billion.

Protective Measures for people and property

Statistics would suggest that in general the US protection from hurricanes is successful in terms of lives not property. Despite decades of increasing population in hurricane-prone regions of the nation, essentially the south eastern states, the storm death toll has generally fallen. Katrina was a shock for a country where deaths from hurricanes was now a rarity. Property damage paints a different picture; with an increasing number of inhabitants – and moreover wealthier ones, especially on the storm-surge-prone coasts of Mississippi and Florida – the insured property at risk has grown. Homes, yachts, cars and other possessions must often be abandoned, though secured as much as possible, during hurricane events. So while prediction and evacuation works well for the population, it is not the answer for their possessions.

Protection and Warning

In August 2005 Hurricane Katrina was precisely tracked from the initiation to the conclusion of its short but violent life. Katrina's scale, strength and landfall locations, first in Florida and later in the delta region, were accurately predicted.

Despite the years of investment and numerous warnings of the threat that a major hurricane posed to the people of New Orleans, evacuation plans proved inadequate. Following the event, a Congressional Report described the government's response to Katrina's impact as a national failure, stating that "…clumsiness and ineptitude… characterised behaviour before and after this storm". Part of the problem was that

over 25% of households in New Orleans did not own cars and had no easy way of evacuating the city. Residents also refused to leave their homes, fearing looting in their absence; some paid for this inaction with their lives.

2. Education

   It appears that despite the official awareness of the risk to New Orleans, most residents had little fear that the city would be badly impacted.

3. Building Codes

   In New Orleans the city's situation – much of it lies below sea level – meant that the flooding was so severe that even the strict building codes did little to reduce the impact. In the aftermath some people have suggested that the worst affected areas of the city should not be rebuilt on such a dangerous site. Others have suggested that the worst affected areas should not be redeveloped but that a smaller population should be catered for, and the flood-prone regions given over to low risk land uses such as parkland or sports pitches.

4. Coastal and river engineering

   The levees and defences along the Mississippi and canals in New Orleans were built to withstand a hurricane up to a category 3, anything beyond that would cause flooding. The cost and practicality of protecting the city and the rest of the region from the worst possible event is prohibitive. Currently the US Corps of engineers, who have the task of rebuilding New Orleans defences, is restoring them to their previous height while the city's mayor wants them raised and improved to deal with category 5 hurricanes.

5. Insurance

   Many households in New Orleans could not afford the premiums required to cover hurricane damage and this explains why in the hardest-hit, working class regions of the city many of the residents have decided not to return.

Management of hazards

Why would people live in hazard-prone areas?

- They may have no/limited choice.
- At collision plate boundaries, hills and mountains are created, this attracts tourists, and is nice scenery.

- Fertile soil - new soil is produced, richer in minerals and nutrients and plants grow better there.
- For example, Japan is very prone to earthquakes. However, people still want to live there as it is a wealthy country. And good jobs can be found there. Economic interests is one of the consideration for people when choosing places to live.

How to prepare the house for an earthquake:

- Secure heavy appliances to studs in the wall so that they are less likely to move.
- Take all heavy objects of shelves, to prevent things from falling on your head.
- Put latches on cupboards to prevent doors from swinging open.
- Make sure all pictures, clocks, e.t.c hanging on the wall are secured, screwed in, so there is no chance of them falling.
- Have safety film put over your windows, glass can break easily in a severe earthquake.
- Make sure all flammable liquids are placed on the lowest shelves of cupboards, or in a garage or garden shed.

What to do in an earthquake scenario:

- Move away from windows
- Arrange a meeting point with family
- Protect your head
- Turn off electricity
- Check for fires
- Hang onto door frame
- Keep away from power cables
- Keep away from trees
- Stop driving
- Get outside it possible
- Turn off gas

- Listen to the radio
- Supplies you will need:
- Food
- Water
- Medical supplies
- General supplies: batteries portable radio e.t.c

Section 3

Inside the earth

Earthquakes and volcanoes

- Destructive plate margins – Where two plates are moving towards each other.
- Constructive plate margins – Where two plates are moving away from each other.
- Conservative plate margins – Where two plates are moving sideways past each other.
- Subduction – Where one plate moves under another.

Structure of the earth

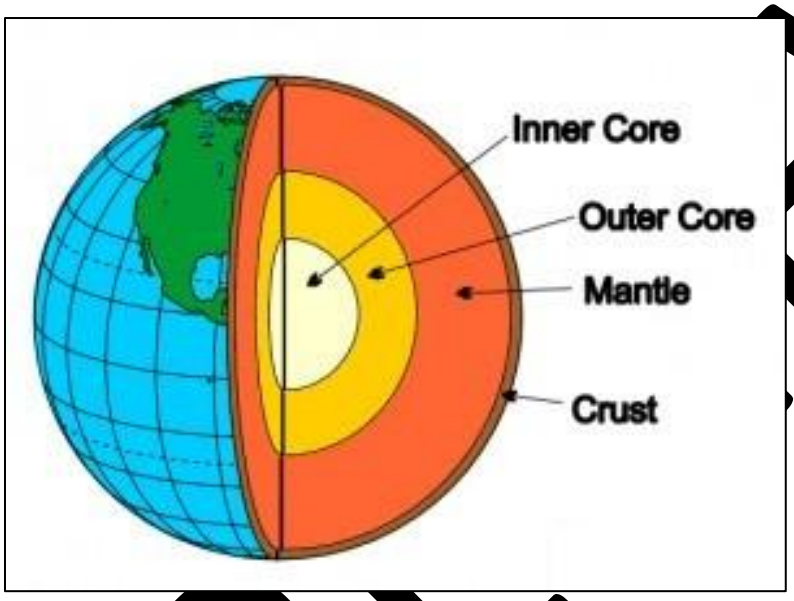
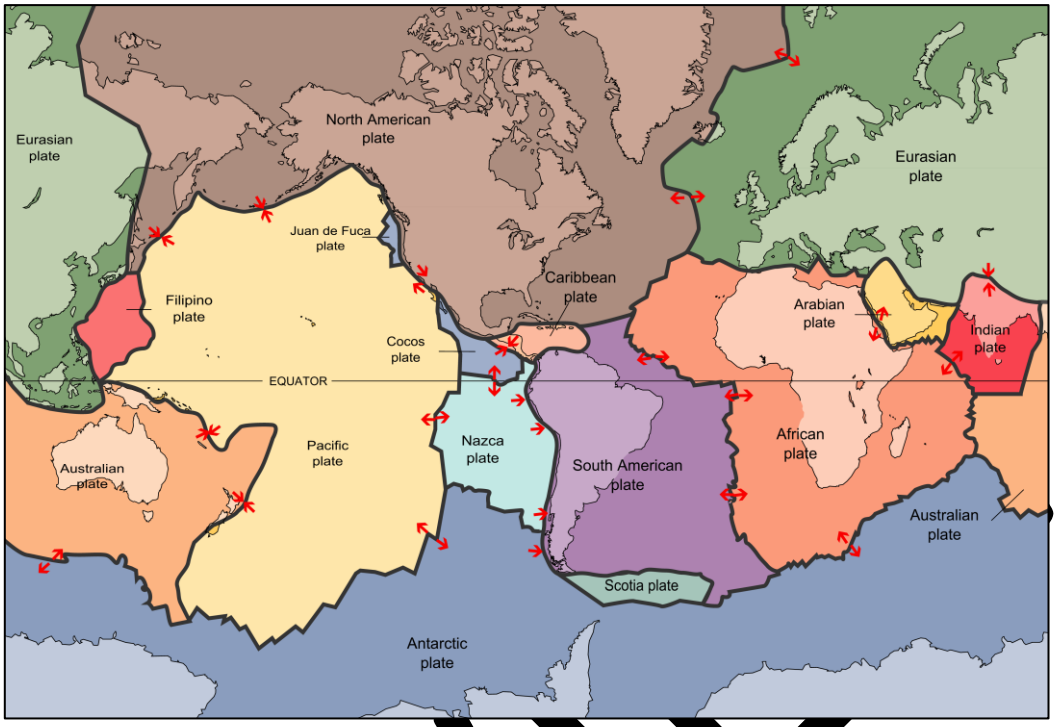


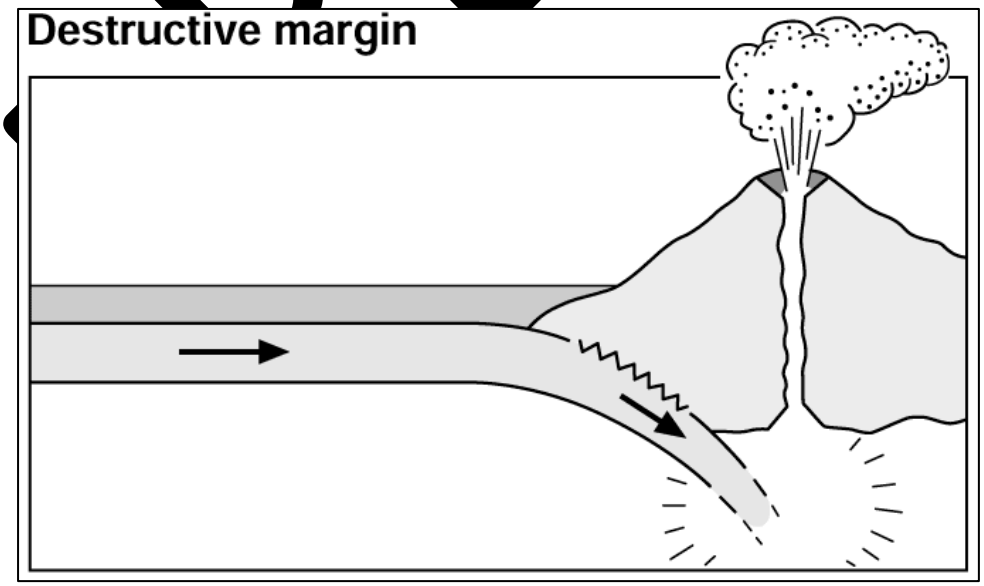
Plate margins



- There are three types of plate margin:

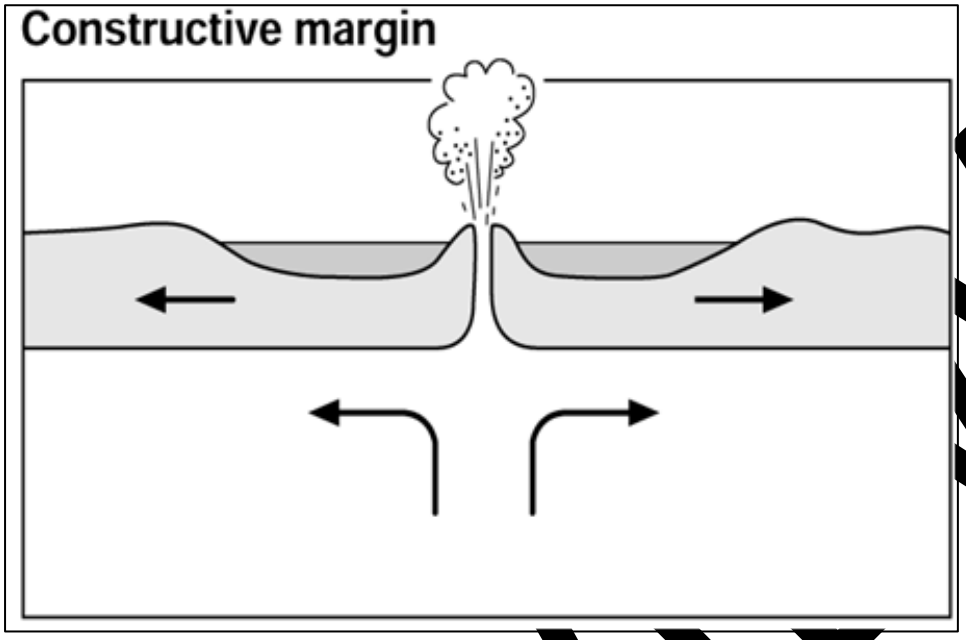
Destructive plate margins

- Where oceanic pla meets a continenta . The denser oceanic plate is forced down into the mantel and stroy
- This ofte reat volcano and ocea trenches.



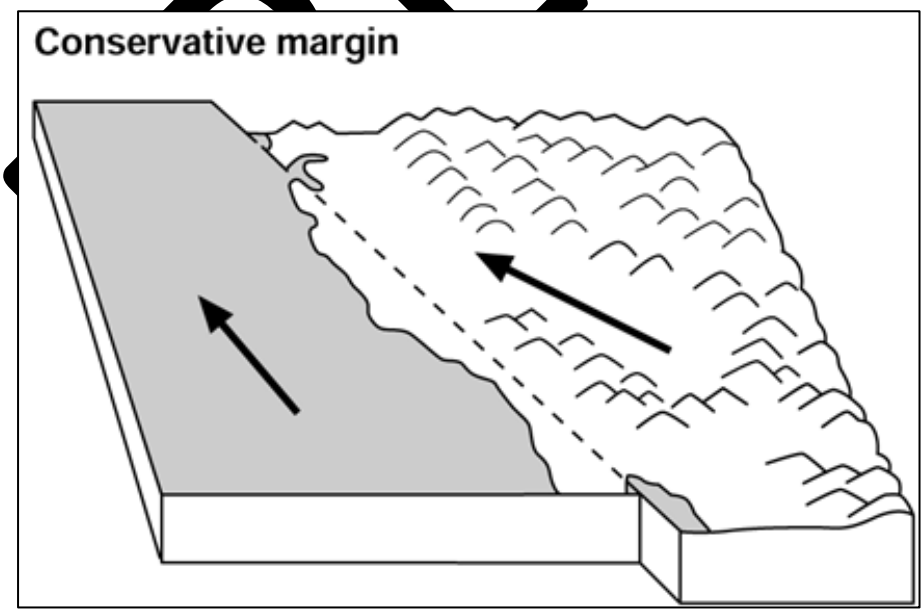
Constructive plate margins

- Where two plates are moving away from each other e.g. The mid Atlantic ridge. Magma rises from the mantle to fill the gap, cools and creates new crust.

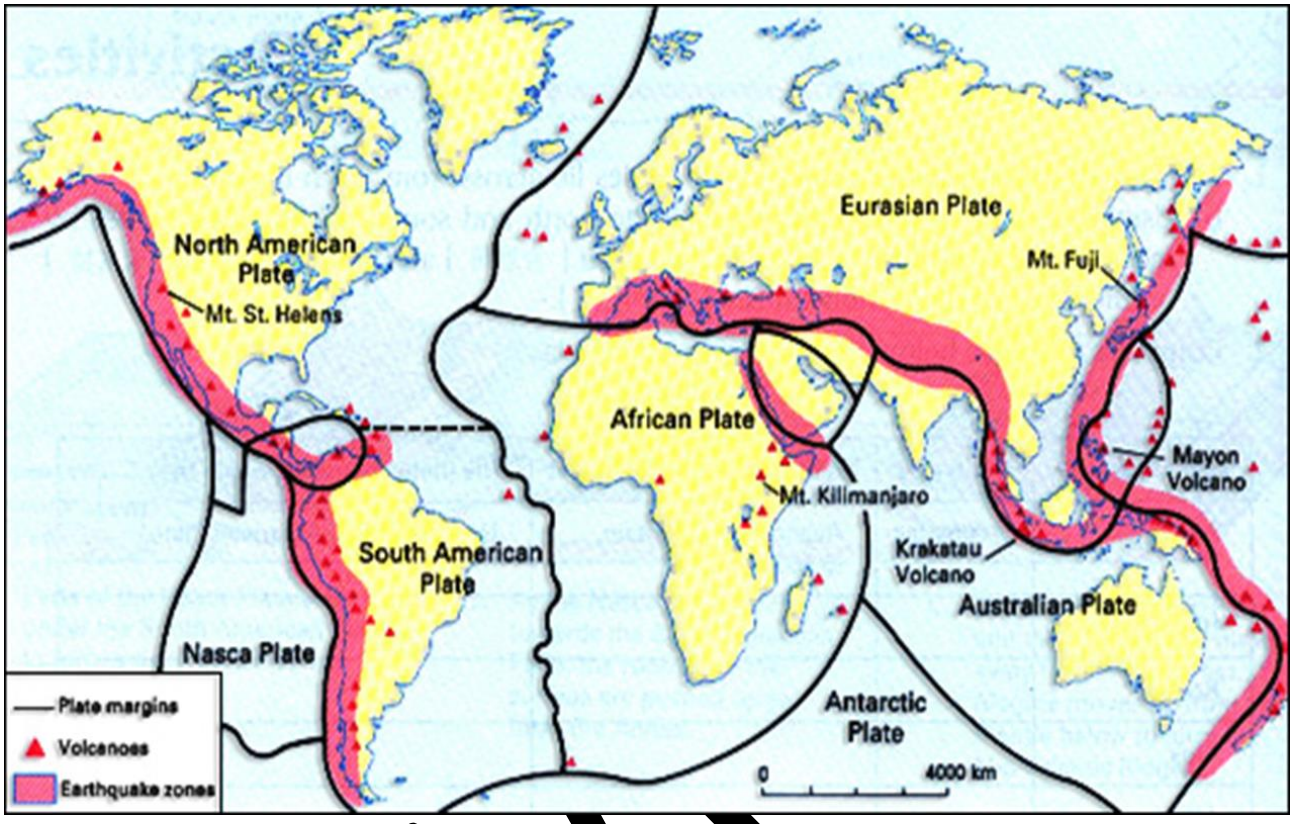


Conservative plate margins

- Where two plates are moving sideways past each other, or are moving in the same direction but at different speeds. E.g. Along the west coast of the USA. Crust is not created or destroyed.



Volcano and earthquake locations

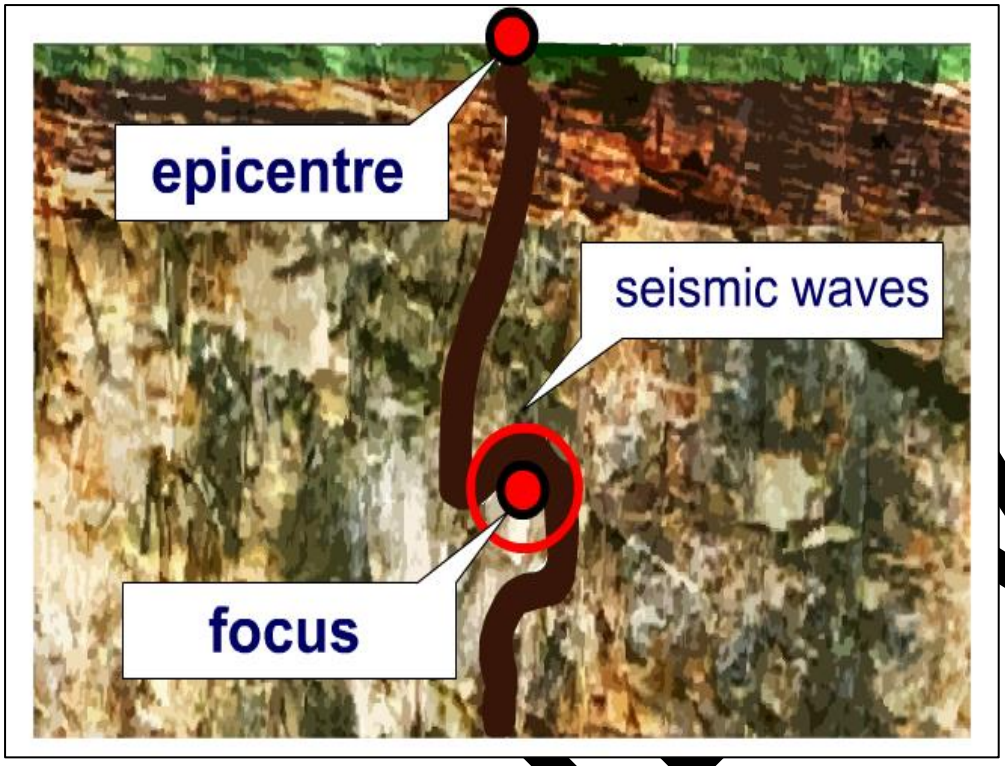


What are earthquakes?

- Earthquakes are vibrations caused by earth movements at plate boundaries and at major fault lines (cracks in the earth's surface).
- They can occur at all four major plate boundaries but the most severe earthquakes are normally found at conservative and destructive plate boundaries.

Epicentre and focus

- The focus is the point at which the rock moves.
- Seismic waves start at the focus.
- The epicentre is directly above the focus on the earth's surface.



- Earthquakes occur at all plate margins, as well as along fault lines that spread out from the main fault. They are particularly violent at destructive and conservative plate margins.
- Over time, stress builds up at these plate margins as plates rarely move continually. When this is suddenly overcome the plate moves, causing the rocks to fracture and creating earthquakes.
- The longer a fault remains locked, the more stress builds up and the greater the chance of having a major earthquake.

Earthquake Waves

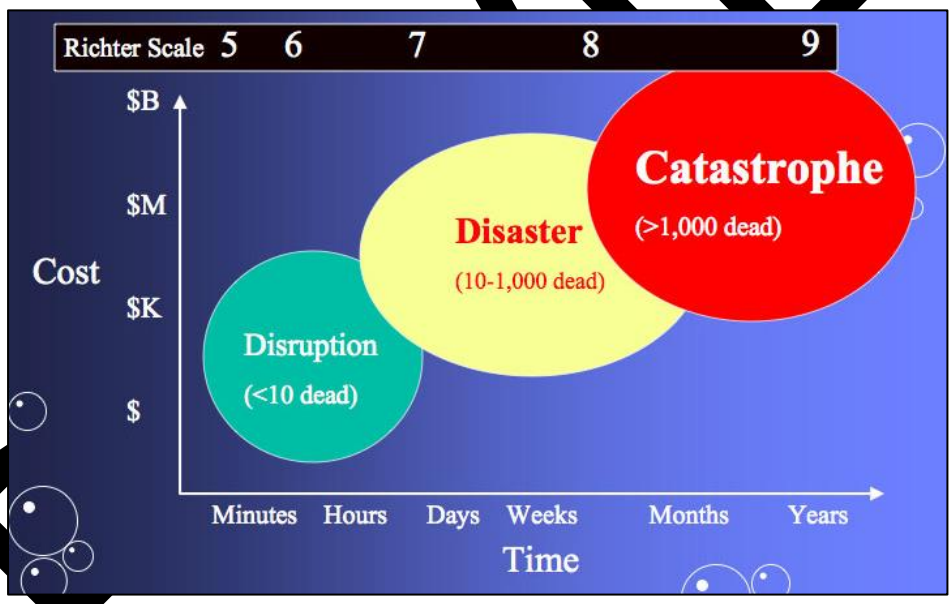
Earthquakes produce two main waves which travel at different speeds (body waves which travel through the Earth and surface waves)

- P-waves are the fastest and travel through both solids and liquids.
- S-waves are slower and can only travel through solids.
- Love waves shake the ground at right angles to the direction of movement; they are faster than Rayleigh waves.

- Rayleigh waves produce both horizontal and vertical ground movement, occurring in a rolling motion. These are what often cause the most damage.

Earthquake Measurement

- Earthquakes are measured on a seismometer.
- The intensity or size of the earthquake is measured on the Richter scale. This records an earthquake's magnitude.
- The Richter scale is logarithmic, so a magnitude 7 earthquake is 10 times more powerful than a magnitude.
- An earthquake larger than magnitude 5 is likely to cause some structural damage to buildings.
- Earthquake intensity (degree of surface shaking) is measured using a qualitative scale called the Mercalli scale.



Measuring earthquakes – The Richter Scale

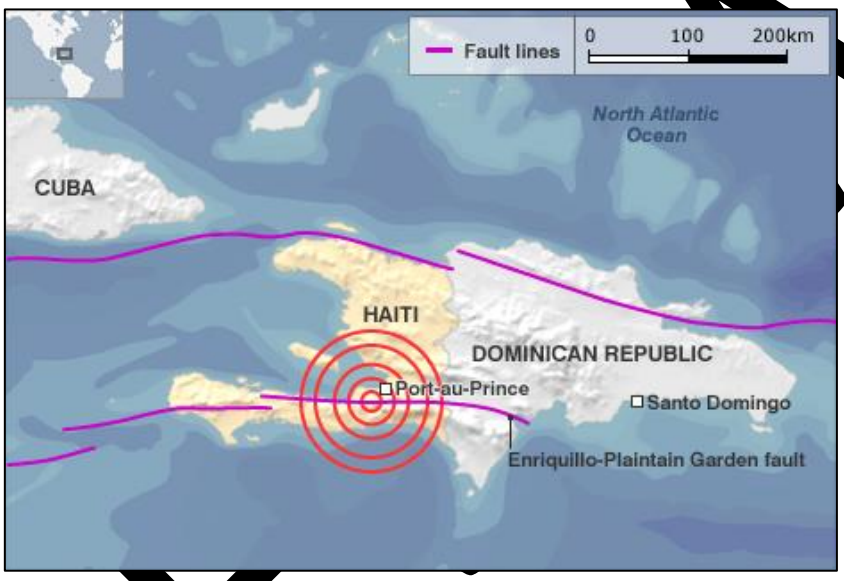
- This measures the magnitude of a tremor (how powerful it is) using an instrument called a seismograph.
- On the Richter Scale, magnitude is expressed in whole numbers and decimal fractions. Although the Richter Scale has no upper limit, the largest earthquake ever recorded was in 1960 in Chile. It measured 9.5 on the Richter Scale.

- It is a logarithmic scale which means that a size '6' on the Richter Scale is 10 times larger than a size '5' and 100 times larger than a size '4'.

Measuring earthquakes – The Mercalli Scale

- The Mercalli scale measures how much damage is caused by the earthquake based on observations.
- It is measured on a scale between 1 and 12.

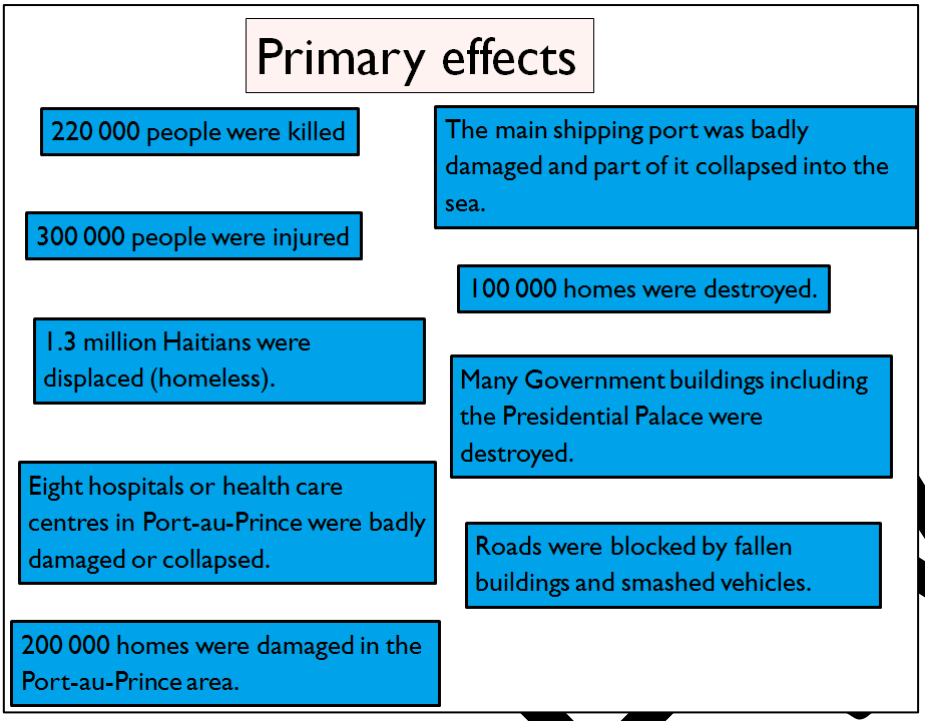
Haiti

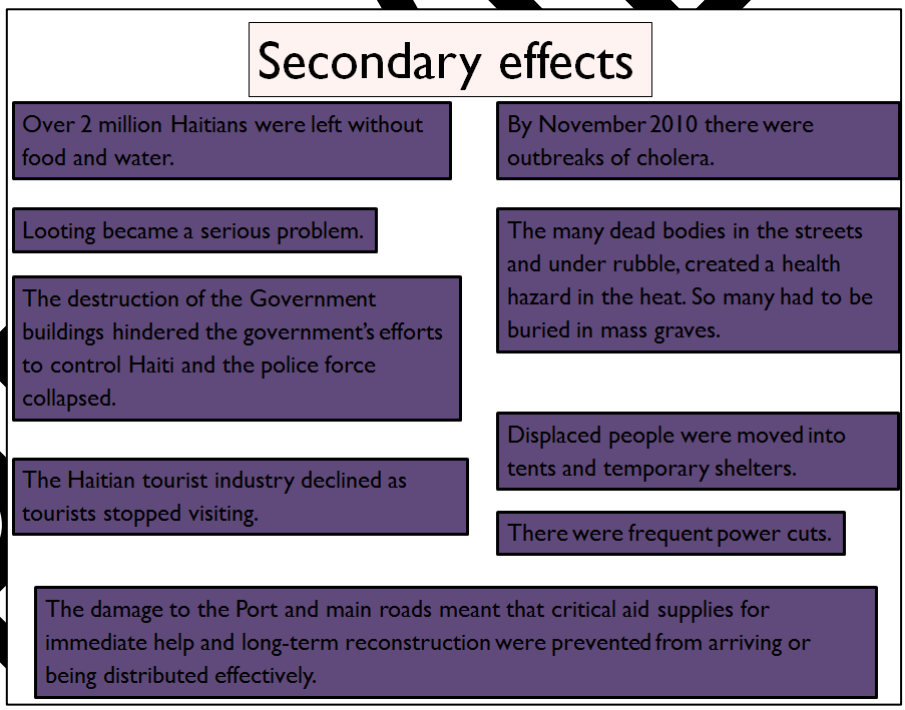


What were the effects of the earthquake?

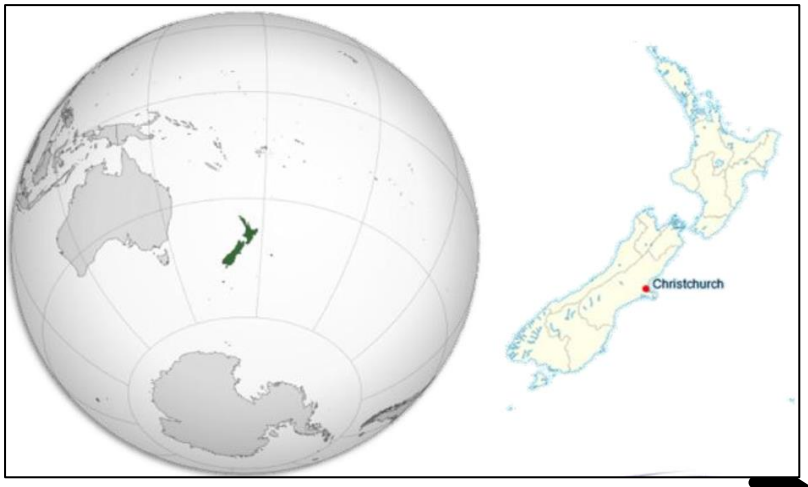
- Primary effects are the things that happen immediately as a result of an earthquake or disaster.

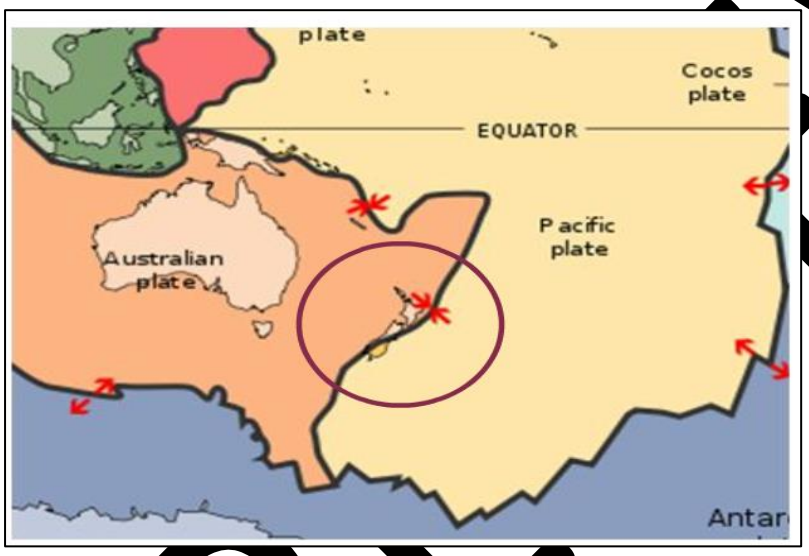
Secondary effects happen in the hours, days and weeks after the initial earthquake.


Primary effects
220 000 people were killed
The main shipping port was badly damaged and part of it collapsed into the sea.
300 000 people were injured
100 000 homes were destroyed.
1.3 million Haitians were displaced (homeless).
Many Government buildings including the Presidential Palace were destroyed.
Eight hospitals or health care centres in Port-au-Prince were badly damaged or collapsed.
Roads were blocked by fallen buildings and smashed vehicles.
200 000 homes were damaged in the Port-au-Prince area.


Secondary effects
Over 2 million Haitians were left without food and water.
By November 2010 there were outbreaks of cholera.
Looting became a serious problem.
The many dead bodies in the streets and under rubble, created a health hazard in the heat. So many had to be buried in mass graves.
The destruction of the Government buildings hindered the government's efforts to control Haiti and the police force collapsed.
Displaced people were moved into tents and temporary shelters.
The Haitian tourist industry declined as tourists stopped visiting.
There were frequent power cuts.
The damage to the Port and main roads meant that critical aid supplies for immediate help and long-term reconstruction were prevented from arriving or being distributed effectively.

New Zealand





- New Zealand is at risk from both earthquakes AND volcanoes because of the plate boundary it

ing with earthquak

- In New Zealand there is an Earthquake Commission which everyone contributes to as part of their insurance cover. This fund stands at billions of dollars.
- There is a strict building code which is reviewed every 10 years and is enforced for all new buildings. Recommendations are made to people with older buildings.
- With most people living in urban areas, it means that the government can make sure that infrastructure is up to the highest standard and emergency services can be fully organised in case of a disaster.

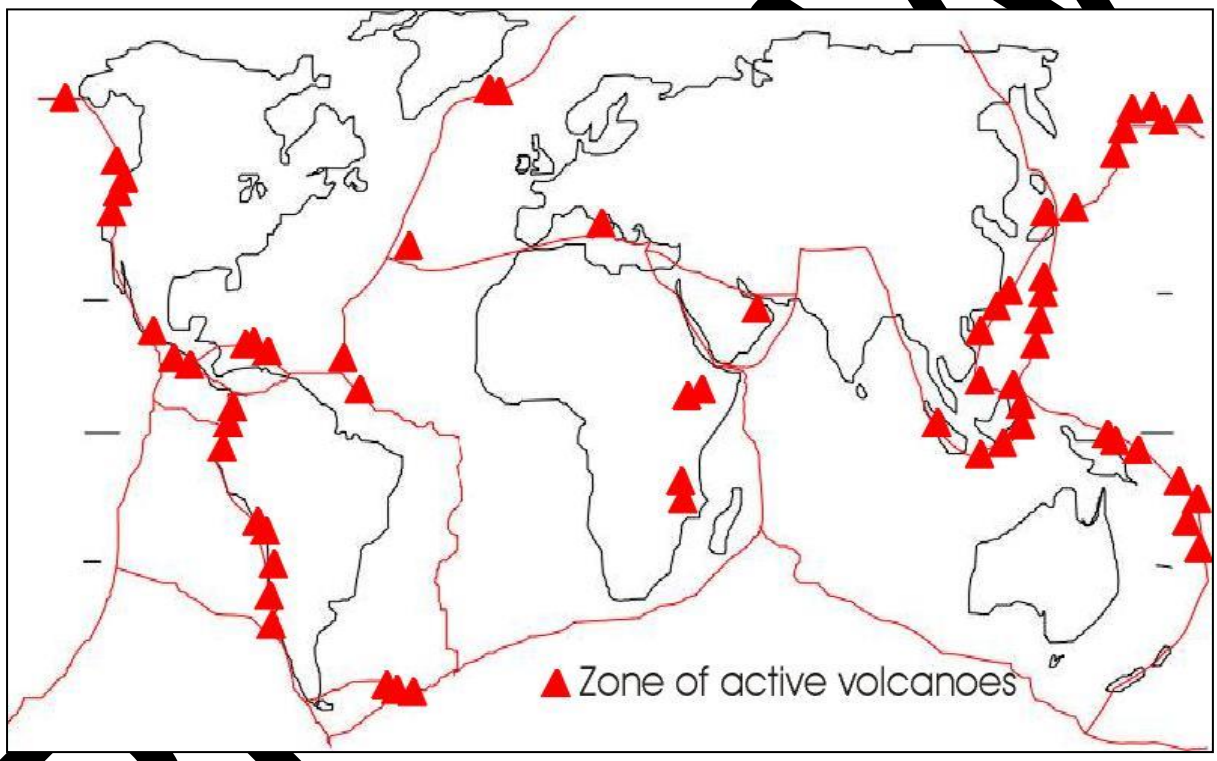
- Education is an important part of living in a tectonic area and everyone knows what to do in an earthquake, a tsunami or when a volcano erupts.

Community is very important, and after an earthquake everyone works together.

Volcanoes

There are three types of volcanoes.

- Active
- Dormant
- Extinct



Shield volcano

Composite volcano

A volcano occurs where the plate movement is either destructive (oceanic crust is sinking) or constructive (plates are moving away from each other). Magma can be thin and runny, or thick and sticky (viscous). Viscous gassy lava causes the most dangerous eruptions because it can't escape from a volcano easily; the pressure builds up until the magma explodes out.

Explosive eruptions produce particles of all sizes, from dust to blocks of rock. These particles collapse, and rush down the slopes of a volcano as a deadly pyroclastic flow.

Mt St Helens Case Study

- NW USA.
- Erupted on May 18th 1980. Activity began in March and for 3 months there was seismic activity as magma rose up in the volcano.
- The magma caused a blockage in the side of the volcano.
- An earthquake measuring 5.1 caused the volcano to explode.

Sector	Federal	Private	State	Local	Total	%Total
Forestry	$168.0	$218.1	$63.7	---	$449.8	46.6
Clean-up	307.9	9.7	5.0	$41.3	363.0	37.4
Property	43.6	44.8	2.5	16.0	106.9	11.0
Agriculture	--	39.1	--	--	39.1	4.0
Income	--	8.9	--	--	8.9	0.9
Transport	--	--	--	2.1	2.1	0.2
Total	$518.6	$320.6	$71.2	$59.4	$969.8	--
Percent of total	53.0	33.1	7.3	6.1	--	--

In millions of dollars (US$)