Edexcel IAL Geography

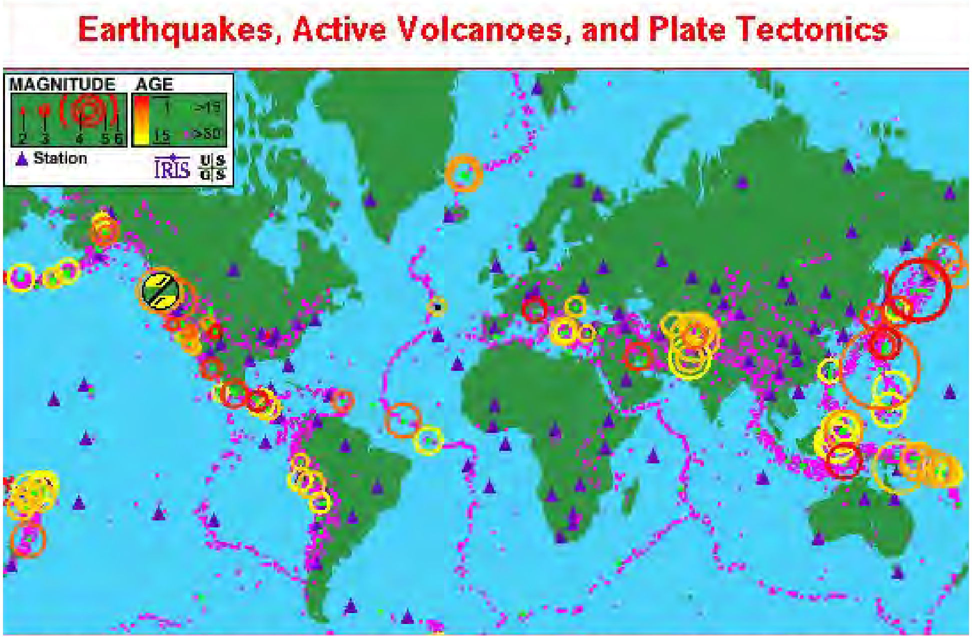
World at Risk

Essential Notes

The Global Distribution of Hazards

- A **hazard** is a potential threat to human life and property.
- A natural hazard can be either **hydro-meteorological** (caused by climatic processes) or **geophysical** (caused by land processes).

Location of Geophysical Hazards



Most geophysical hazards (earthquakes, volcanoes) occur **near plate boundaries**. Earthquakes can occur near the middle of plates (called **intra-plate**). The causes of this are not fully understood but it is assumed that plates have **weaknesses**. **Volcanic hotspots** can also situated amongst the centre of pates. At hotspots, such as the Hawaii hotspot, **magma** rises as plume (hot rock). Usually, the most powerful earthquakes occur at **convergent or conservative** boundaries.

Location of Hydrometeorological Hazards

Hydrometeorological hazards are **more common** than geophysical hazards. They can occur anywhere. **Hurricanes** tend to affect coastal settlements along **warm bodies of oceans** (Pacific Ocean, Atlantic Ocean near the Equator). **Flooding** will occur more often for retreating coastlines, rivers with rapid hydrographs and melting glaciers. **Droughts** tend to occur in Saharan or Semi-Arid climates, where water availability is limited. Droughts can also be caused by long-period **anticyclones**, where high rates of evaporation will increase water stress.

Occasionally, a geophysical hazard may cause a hydrometeorological hazards. For example, a volcano may superheat a local glacier, causing a **Jokulhlaup**.

Types of Hazards

Causes of Geophysical Hazards - Plate Movement

At plate boundaries, different plates can either move **towards each other** (**destructive** plate margin), **away from each other** (**constructive** plate margin), or **parallel** to each other (**conservative** plate margin). Different landforms are created in these different interactions. This spider diagram outlines what landforms and processes occur at the boundaries.

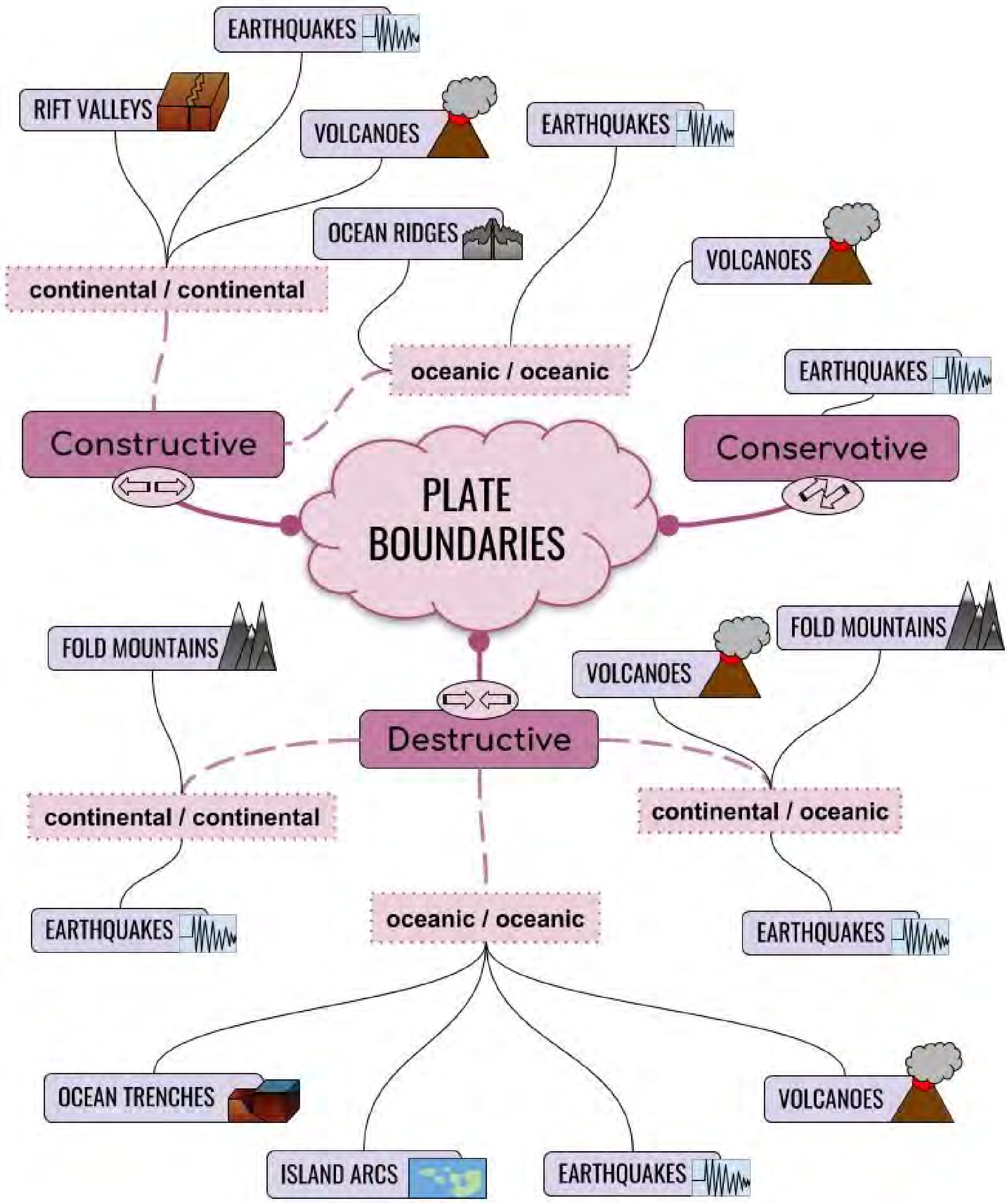
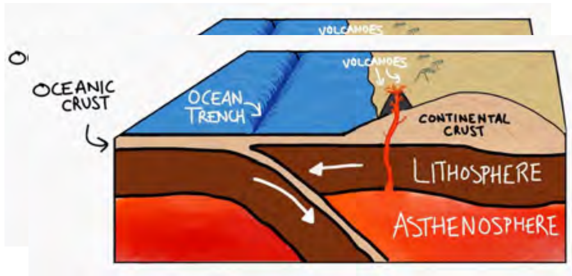
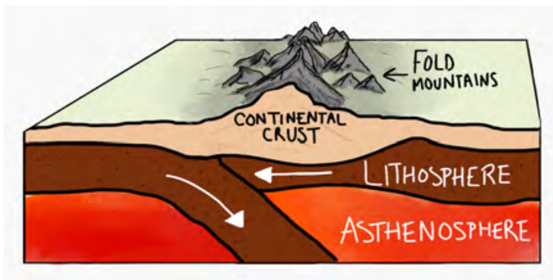


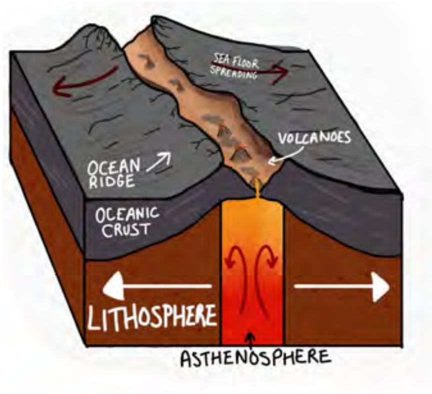
Plate Boundaries

Destructive plate boundaries	
Continental and oceanic: • Denser oceanic plate **subducts** below the continental. • The oceanic crust is melted as it subducts into the asthenosphere. • The extra magma created causes **pressure** to build up. • Explosive, high pressure volcanoes erupt through the continental plate, known as **composite volcanoes**. • **Fold mountains** occur when sediment is pushed upwards during subduction.	
Oceanic and oceanic: • Heavier plate **subducts** leaving an ocean trench. Fold mountains will also occur. • Built up pressure causes **underwater volcanoes** bursting through oceanic plate. • Lava cools and creates new land called **island arcs**.	
Continental and continental: • Very little difference in density of plates so lots of **pressure builds.** • Ancient oceanic crust is subducted slightly, but there is **no subduction of continental crust.** • **Pile up** of continental crust on top of lithosphere due to pressure between plates. • **Fold mountains** formed from piles of continental crust.	

Constructive plate boundaries

Oceanic and oceanic:

- Magma rises in between the **gap left by the two plates separating**, forming new land when it cools.
- Less explosive underwater volcanoes formed as magma rises.
- **New land** forming on the ocean floor by lava filling the gaps is known as **sea floor spreading** (as the floor spreads and gets wider).

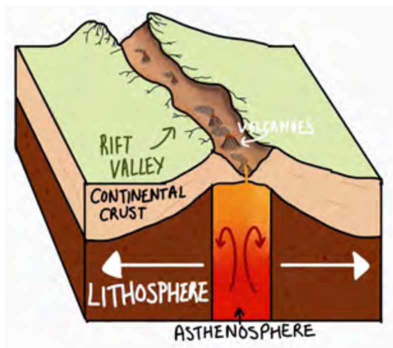


Evidence

There is sufficient evidence to prove plate movement, and **sea floor spreading** (theorised by **Harry Hess** in the 1940s) provides some of this proof. **Paleomagnetism** is the study of rocks that show the magnetic fields of the Earth. As new rock is formed and cools the magnetic grains within the rock align with the magnetic poles. Our poles (North and South) **switch** periodically. Each time these switch the new rocks being formed at plate boundaries **align in the opposite direction** to the older rock. On the ocean floor either side of constructive plate boundaries, Geologists observed that there are **symmetrical bands** of rock with **alternating bands of magnetic polarity**. This is evidence of seafloor spreading.

Continental to continental:

- Any land in the middle of the separation is forced apart, causing a **rift valley**.
- Volcanoes form where the magma rises.
- Eventually the gap will most likely fill with water and separate completely from the main island.



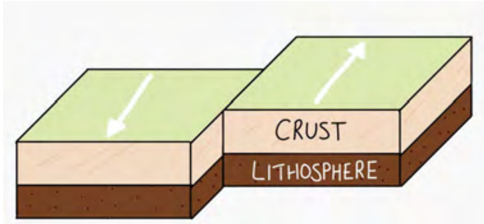
There are further forces influencing how convergent boundaries occur -

Ridge push:

The **slope** created when plates move apart has **gravity acting upon it** as it is at a **higher elevation**. Gravity pushes the plates further away, widening the gap (as this movement is influenced by gravity, it is known as **gravitational sliding**).

Slap pull:

When a plate **subducts**, the plate sinking into the mantle **pulls the rest of the plate** (slab) with it, causing further subduction.

Conservative plate boundary	
Between any crust, the **parallel plates** move in **different directions** or at **different speeds**. No plates are destroyed so no landforms are created. When these plates move, a lot of pressure is built up. On oceanic crust, this movement can displace a lot of water. On continental crust, **fault lines** can occur where the ground is cracked by the movement.	

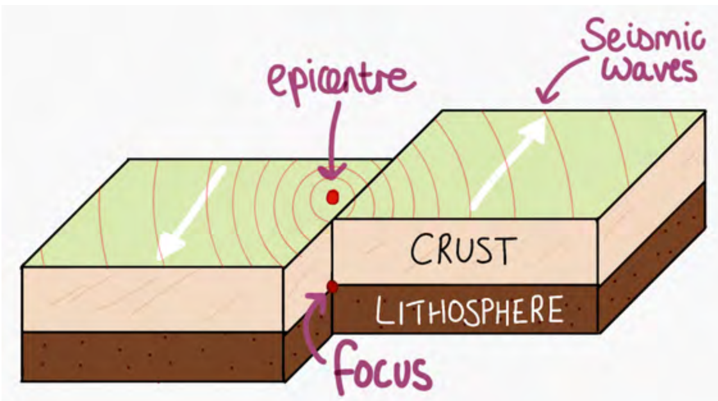
Types of Geophysical Hazards

Earthquakes:

Plates do not perfectly fit into each other, meaning they do not move in **fluid** motions. At all boundaries, plates can become stuck due to the **friction between plates**.

When the plates are stuck, the **convection currents** in the asthenosphere continue to push, which builds the pressure. It builds so much that it cannot be sustained and the plates eventually **give way**. All of this pressure is released in a sudden movement, causing a **jolting motion** in the plates. This jolt is responsible for **seismic** movement spreading throughout the ground in the form of **seismic waves** (or shock waves).

The **focus** (or hypocentre) is the point underground where the earthquake originates from. The **epicentre** is the area above ground that is **directly above** the focus.



Seismic Waves

Primary -Travels through solids -Compressional -Vibrates in the direction of travel - Travels at 4-8 km/s	**Secondary** -Vibrate at right angles to direction of travel -Travels only through solid rocks -Travels at 2.5 - 4 km/hr
Love -Near to ground surface -Rolling motion producing vertical ground movement -Travels at 2-6 km/hr	**Rayleigh** -Vertical and horizontal displacement -Travels at 1-5 km/hr -Compressional

Secondary and Love waves are the most destructive as they have **large amplitudes**. Due to their different speeds, these different waves will hit a location at different times. The **aftershocks** that survivors feel are these different types of waves arriving after each other. **Intensity** of waves will **decrease further from the epicentre**, as waves lose energy as they travel.

Secondary Hazards of Earthquakes

- **Landslides** - Weakened cliffs, hills or snow will fall under mass movement.
- Building Collapse and **subsidence**
- **Soil Liquefaction** - soil behaves like a liquid as moisture is shaken to the surface.
- **Tsunamis** - If earthquake occurred at an oceanic plate boundary, water will be displaced vertically.
- **Fire** - Often due to ruptured gas lines
- **Disease** - Spread quickly through a population following an earthquake, since residents have lost their sanitation and basic necessities.

Volcanoes

Primary hazards, caused directly from the volcano, tend to have a **fast speed of onset**:

- **Lava flows** – Streams of lava that have erupted onto the Earth's surface.
- **Pyroclastic flows** – This is a mixture of hot dense rock, lava, ash and gases which move very quickly along the surface of the Earth which can cause **asphyxiation** for anyone unfortunately caught by the flow.
- **Tephra and ash flows** – When pieces of volcanic rock and ash are blasted into the air.
- **Volcanic gases** – Gases like **sulphur dioxide** and **carbon monoxide** are released into the atmosphere.

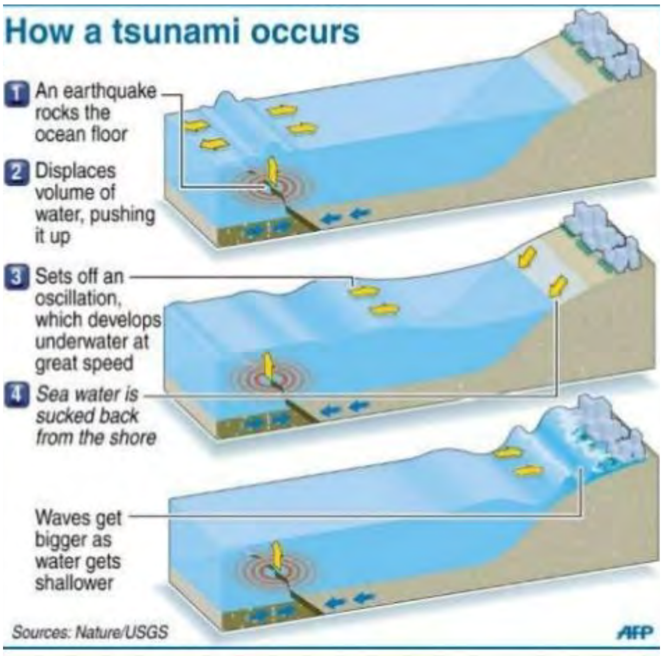
Secondary hazards occur as a result of the heat produced by the volcano:

- **Lahars** – Combination of **rock, mud and water** which travel quickly down the sides of volcanoes.

- **Jokulhlaup** – Snow and ice in glaciers melt after an eruption which causes **sudden floods**.
- **Acid rain** - caused when gases such as **sulfur dioxide** are released into the atmosphere.

Tsunamis:

- When an oceanic crust is jolted during an earthquake, all of the water above this plate is **displaced** vertically.
- This water is then pulled back down due to gravity. The energy is transferred into the water and waves travel outwards.
- As it gets closer to the coast, the sea level decreases so there is friction between the sea bed and the waves.
- This causes the waves to slow down and gain height, creating a wall of water that is on average 10 feet high, but can reach 100 feet.

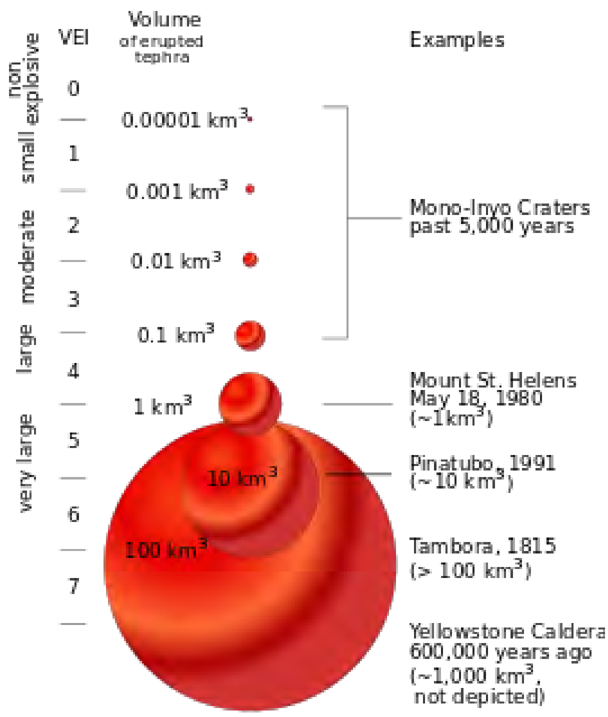


Tsunamis are generated generally in **subduction zones** at convergent plate margins. Most tsunamis are found along the Pacific ring of fire, hence the most vulnerable countries are often located in Asia or Oceania.

Measuring Geophysical Hazards:

Volcanic Explosivity Index (VEI)

- Measures the **relative explosiveness** of a volcanic eruption.
- Based on the **height** of ejected material and **duration** of eruption.
- Scale goes from 0-8 and is **logarithmic** (increase of 1 on the scale indicated a 10 times more powerful eruption).



Moment Magnitude Scale

- Measures the amount of **energy** released in an earthquake.
- Scale from 0-9.
- It's a **simple** measure, so environmental or social impacts must be inferred.

Types of Hydro-Meteorological Hazards

Flooding

Flooding tends to occurs at two common locations: on the **banks of a river** and at the coast during **storm surges**. There are several causes of flooding:

1. During a **low-pressure weather system** (tropical cyclone, depression), low pressure can displace a volume of seawater upwards. This will cause **storm surges**.
2. A **large volume of rainfall** over a prolonged amount of time will cause the ground to become **saturated**, meaning further rainfall must flow as **surface runoff**. This causes rivers to flood as they are unable to cope with the increased rapid surface runoff
3. In climates prone to snow (e.g. Tundra), sudden **snowmelt** will cause flooding. This may be due to glaciers melting due to a volcano (**jokulhlaup**) or naturally melting.

Factors Affecting Flooding:

- **Impermeable rocks** like granite which encourage rapid surface runoff.
- **Relief** can reduce the time taken for water to travel from source to river channel. High and steep slopes → More runoff
- Intense **storm precipitation** or **rapid snowmelt** can create an influx of water, which exceeds the infiltration capacity of soil.
- Low density **vegetation**, therefore less interception and plant uptake, so more rapid movement of water
- **Human activities** can increase the risk of flooding:
  - **Urbanisation** - More concrete surfaces and impermeable materials built with, so less water can infiltrate the ground.
  - **Deforestation** - Reduced vegetation and trees, therefore reduced uptake through plants' photosynthesis and so more water runs directly into the river causing flash flooding.

Droughts

An **imbalance** in inputs and outputs of water can have serious implications for the hydrological cycle. A **deficit** (more commonly known as a **drought**) refers to when input is less than output. This deficit can be caused by natural and/or human factors.
Droughts are commonly caused by:

➔ A lack of precipitation, over a long period of time, depleting groundwater stores.
➔ Over-extraction for domestic, industrial and agricultural uses.
➔ Vegetation is unable to intake enough water, due to limited water moisture in the soils. This can cause crop failure and increase the risk of wildfires

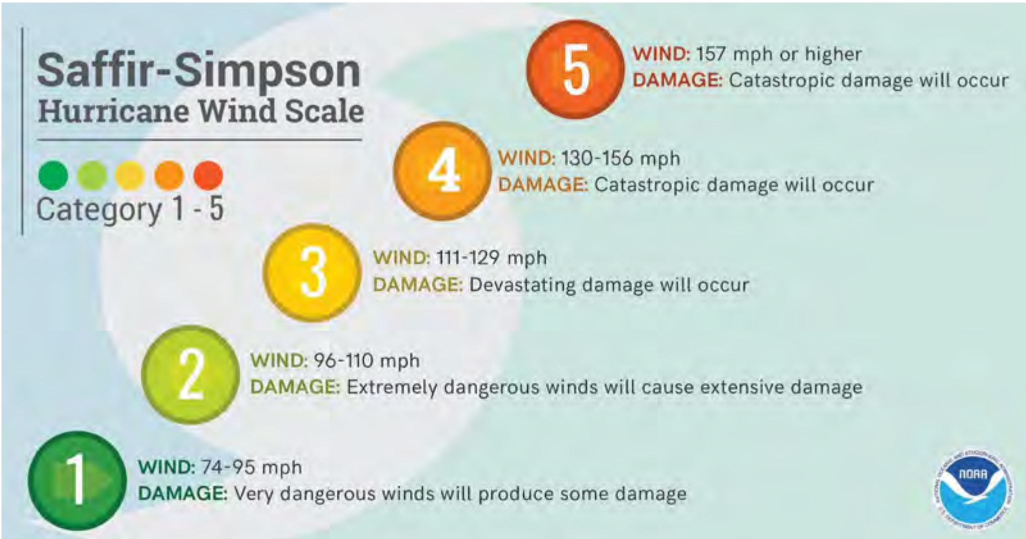
El Nino

El Nino Southern Oscillations (ENSO) are the **change** in water body patterns within the Southern hemisphere, leading to unusual weather conditions. The causes of El Nino aren't fully understood. Normally cool water is found along the Peruvian coast, and warm waters are found around Australia. ENSO causes this to switch (Peru gets warm waters, whereas Australia get cold water) and usually occurs every 3 to 7 years, generally lasting for 18 months. ENSO can also trigger **extremely dry conditions** in areas South and South-East Asia, Eastern Australia and North-East Brazil. In South Asia, ENSO can **weaken the annual monsoon**.

Measuring Hydrometeorological Hazards

Flood Discharge:
- The **volume of water** that passes a particular area per second.
- Often measured in cubic metres per second ($m^3 s^{-1}$)
- Discharge can indicate changes to **patterns in precipitation** or changes to the **river's channel capacity**, as well as measuring the **severity of a flood**.

Saffir-Simpson
- Measures the severity of a **tropical cyclone**
- Scale 1-5, where 1 is a weak hurricane and 5 is a major hurricane.
- The **wind speed** is the factor to measure. Low wind speeds tend to be low energetic cyclones, so little damage is caused.



Disaster, Risk and Severity of Natural Hazards

Disaster – A serious disruption of the functioning of a community or society involving human, material, economic and environmental losses which exceed the ability of the affected community or society to cope using its own resources.

The **risk** a community faces from a natural hazard can be calculated from the equation below:

$$\text{Risk (R)} = \frac{\text{Hazard (H)} \times \text{Vulnerability (V)}}{\text{Capacity to cope (C)}}$$

How **developed** a country is significantly affects how **resilient** its population is and their **capacity to cope** with a hazard.

A place may be at high risk if:

- Their **capacity to cope** is low - limited warning, infrastructure or mitigation are available to protect people at risk.
- They are quite **vulnerable** - whether they have little training or knowledge of the hazard, or live in an environmentally vulnerable location.
- The **hazard** itself is severe - high magnitude, large aerial extent, fast speed of onset, long duration.

Measuring the Severity of a Disaster:

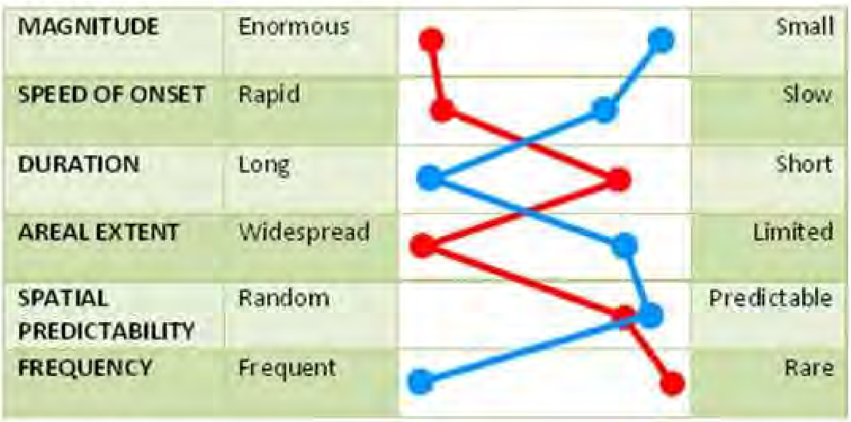
There are many ways to measure a disaster, using simple measures or indices:

➔ **Fatalities** - The number of people killed by a hazard or the secondary hazards immediately affected.

➔ **Economic Loss** - The value of assets and property destroyed, the loss of economic productivity in the days following and during evacuation, the value of insurance claims to be made.

To compare disasters, many use **hazard profiling** to compare similar characteristics, including:

- Speed of Onset
- Economic Loss
- Magnitude
- Frequency
- Fatalities
- Aerial Extent
- Spatial Predictability
- Duration



The impacts of a natural hazard have changed over time. Nowadays, countries have **fewer fatalities** (due to improved technology and knowledge), **larger populations affected** (as more people live in hazardous locations) and **increased economic loss** (due to more people buying insurance).

Tectonic Mega-Disasters

- Large scale disaster affecting a **large spatial areas** or **large population.**
- They pose problems in effective management to minimise the impacts.
- The scale of the impact may require **international support and aid.**
- Mega Disasters are **low probability** (rare).

The globalisation of production and supply chains has allowed **international businesses** to reduce costs and become more efficient. However, mega-disasters significantly damage globalised businesses.

There are many different examples of mega-disasters:
- 2011 Tohoku earthquake and tsunami
- 2011 Eyjafjallajökull eruption
- 2005 Hurricane Katrina

Multiple Hazard Zones
There are certain countries that are at risk from multiple geophysical and hydro-meteorological hazards, which are called **Multiple Hazard Zones**.

Due to the sheer number of hazards present, a multiple hazard zone may have **limited development**:
- ➔ **Weak infrastructure** as it is vulnerable to damage and can be expensive to constantly replace.
- ➔ Economic **pressure on health** services, as repeated hazards may cause repeated injuries or multiple disease outbreaks (in the aftermath).
- ➔ **Population migration** away to avoid risk to life.

However, some multiple hazard zones may thrive due to increased **tourist and geological interest**. The revenue created by tourism can fund mitigation and education, and so the local population becomes less vulnerable.

Multiple Hazard Zones include: The Philippines, Haiti, New Zealand.

Managing Hazards
Hazards can be responded to by **preventing** them directly, being **prepared** for the next hazard, **mitigating** the effects, or completely **adapting** your lifestyle to limit the hazard's effects.

Monitoring and Prediction:
It is not possible for us to **predict accurately** when an earthquake will happen; instead, the risk of an earthquake can be **forecast** based on a statistical likelihood, determined from past earthquakes.

Scientists can sometimes predict volcanic eruptions with some degree of **accuracy**. Scientists can use special equipment to monitor volcanoes and detect signs of imminent eruption:
- Small earthquakes - called **tremors**
- Changes to the **top surface** of the volcano as it swells when magma builds up
- Changes to the **tilt** as the slope angle changes when magma builds up

Mitigation:
Mitigation identifies the **characteristics** of the potential hazard and what can be done to **reduce their impact** on people, such as:
- Land use zoning
- Building codes and regulation

- Protective defences (tsunami wall)

Preparedness:
Preparedness involves minimising loss of life and property
- Developing preparation plans
- Developing warning systems
- Stockpiling medicines, food, water etc.
- Education, training, drill

Response:
Coping with a disaster, the main aims would be to rescue people and reduce economic losses:
- Search and rescue efforts
- Evacuating people
- Restoring vital infrastructure like water and electricity
- Restoring vital services like law enforcement and health care

Management Approaches
There are **three** different approaches to managing a tectonic hazard and reducing their impact: **Modify the Event, Modify the Vulnerability, Modify the Loss**.

Modify the Event
We cannot control seismic activity. However, we can control the **design of buildings** (said to be the biggest **killer** during a natural disaster) through civil engineering using micro and macro methods.
Micro → Strengthening individual buildings and structures
Macro → Large scale support and protective measures designed to protect whole communities

Modify the Vulnerability
Rather than trying to change the hazard itself, we control the population at risk. For example, land zoning and relocation will reduce the population living in the vicinity of a hazard. Alternatively, education will reduce the vulnerability of the population by teaching how to react to a hazard and the warnings and prior conditions to look out for.

Modify the Loss
Modify the loss aims to provide aid to reduce deaths due to loss of infrastructure and increased risk of disease. Insurance offers compensation for losses, for homes, businesses and injuries sustained by the hazard.

Global Climate and Temperatures

The earth has experienced many periods in which temperatures were **much colder** than they are currently. Aside from an ice age around 300 million years ago, the most recent major **ice age** occurred in the **Pleistocene era**. The period spanned from around 2.5 million years ago to 11,700 years ago.

During this ice age, there were many **fluctuations** in global temperatures:
- **Glacial** period: **colder** temperatures, causing glacial **advances** and sea levels to fall.

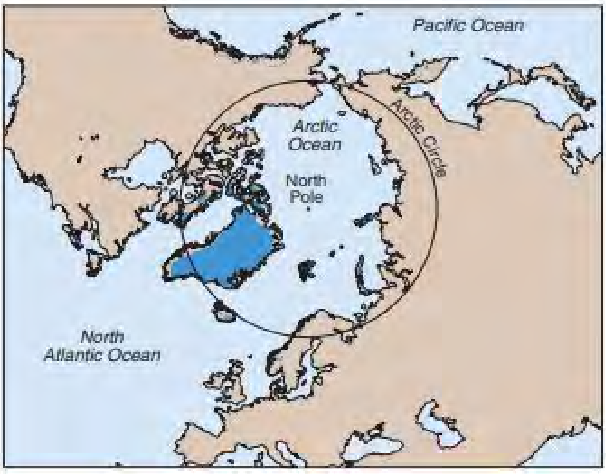
- **Interglacial** period: **warmer** temperatures, causing glacial **retreats** and sea levels to rise.

The most recent period of glacial advance (**Last Glacial Maximum**) was around **21,000 years ago**, and the present distribution of cold environments is much more isolated in comparison to this period.

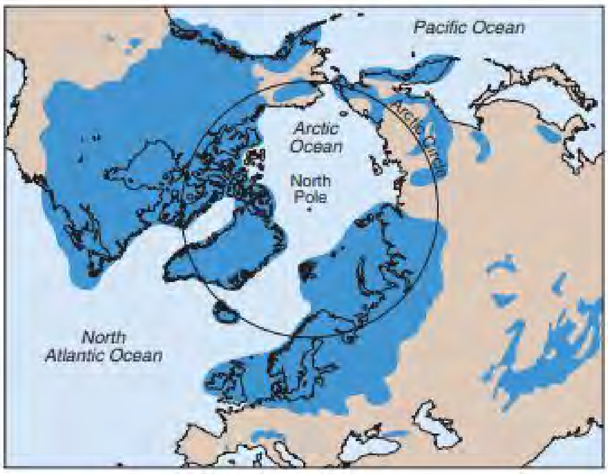
This interactive timeline outlines global temperature trends since the last **glacial maximum**. (https://www.iflscience.com/environment/this-temperature-timeline-of-earth-shows-exactly-how-nonsensical-climatechange-deniers-really-are/)

A much larger area of the northern hemisphere was completely covered by ice, including the majority of the UK.

Present distribution of ice sheets.



Last glacial maximum distribution of ice sheets.



Source: http://www.open.edu/openlearn/ocw/pluginfile.php/614637/mod_resource/content/1/e500_11_sci_sk1_05t.pdf

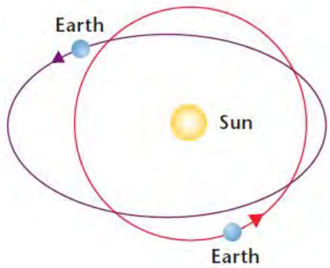
Evidence for Changing Climates:

There is evidence for the change between glacial and interglacial climates across history:

1. **Tree Rings** - A tree's rings are determined by the climate it grows in; if a tree grows in fertile soils during a warm period of time, then its ring for the year will be wider.
2. **Ice Cores** - As glaciers build in the Arctic and Antarctic, air pockets may form, trapping the atmosphere conditions of that time. Scientists can use these pockets to determine the composition of greenhouse gases in the atmosphere in the past.
3. **Pollen** - The distribution of pollen across the plant indicates past distributions of plant growth. Since different plants can only grow in particular climates, pollen can be used to determine previous climates for a particular region.

Long Term Causes of Glacial Periods

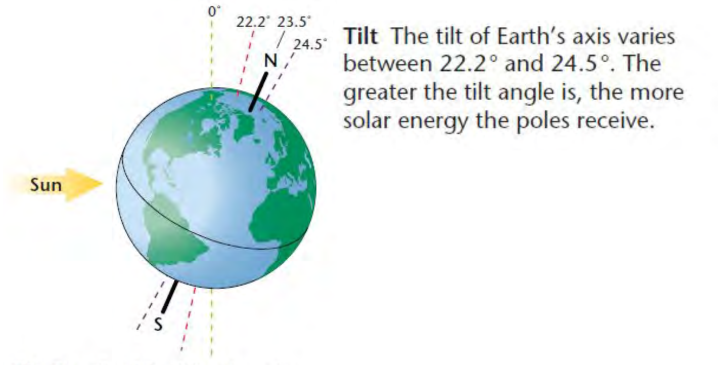
One piece of evidence to explain **long term climate change** is the Earth's **Milankovitch Cycles**. Milankovitch's theory suggests that changes to Earth's orbit will affect the climate. These changes involve:

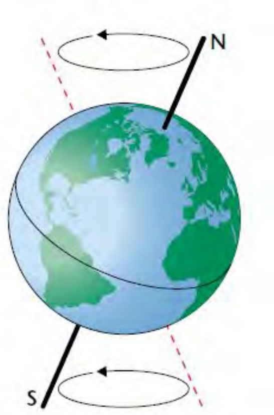


Eccentricity Earth encounters more variation in the energy that it receives from the sun when Earth's orbit is elongated than it does when Earth's orbit is more circular.

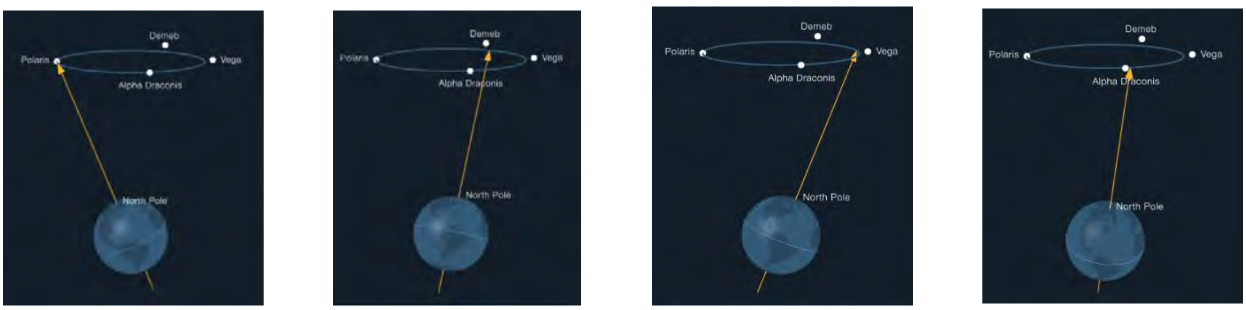
a) **Stretch/Eccentricity**: The earth's orbit changes from **circular to eclipse** every 96000 years, which changes the distance between the earth and the sun. Therefore, the Earth will be closer to/ further away from the sun at different points in its orbit.

b) **Tilt**: The Earth's **tilt** changes between 21.8 degrees and 24.4 degrees every 41000 years. If the tilt is greater the tropics receive more energy and thus become larger.





c) **Wobble/Axial Precession**: Over time, the **direction in which the axis tilts** changes (in the same way that a spinning top moves). In 22000 years, the axial tilt spins one whole time around. This does not affect how much sun the Earth receives overall, only where the solar radiation is distributed (i.e. which hemisphere).



(Source: grahamhancock.com; https://i.stack.imgur.com/D93Lk.gif)

Short Term Causes of Glacial Periods

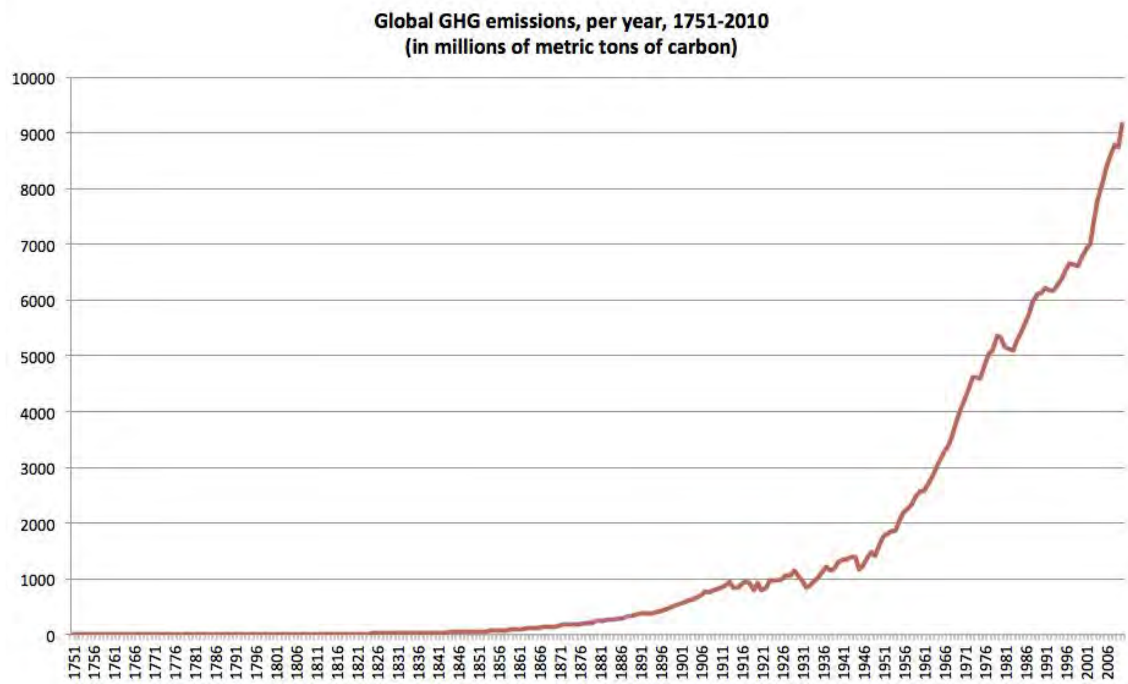
Short Term causes of Climate Change involve:

- **Variations in Solar Output**: **Energy output of the sun** is not constant. **Sunspots** occur by magnetic storms, forming dark areas on the sun which increase solar output. Sunspots aren't regular and can vary.
- **Volcanic Eruptions**: For instance, Mount Tambora in Indonesia erupted in 1815 and lowered global temperature by 0.5 degrees Celsius. It is sulfur dioxide (rather than the ash) which is released during an eruption and reflects radiation for several years.

Past climate trends have been argued, as well as how the climate will change in the future (naturally or due to anthropogenic influence).

Global Warming

Since the 1750s (when industrialisation began in the UK), global concentrations of **greenhouse gases** like CO_2 and CH_4 have increased by more than **25%.** Since the 1980s, **75%** of carbon emissions have come from **burning fossil fuels**.



Source: www.easterbrook.ca

Human activities have led to more carbon being released into the atmosphere and less being absorbed:

- **Farming Practices:** In the Amazon, around **70% of deforestation is for cattle ranching**. Cattle produce significant amounts of **methane**, further contributing to global warming.

- **Fertilisers** are a significant source of greenhouse gases as well as **rice padi fields**, which produce large quantities of methane.
- **Deforestation:** In total, **deforestation accounts for about 20% of all global greenhouse emissions**. The main impact is when the cycle is interrupted and the land is used for other purposes, which then reduces carbon sequestration and land becomes a **carbon source** rather than a **carbon sink**.
- **Urbanisation:** This is the process of **replacing the countryside with buildings and other similar infrastructure**. It affects the **local and global carbon cycles**, by replacing vegetation and covering soils. Most urban areas are constructed from cement and concrete, both processes release **greenhouse emissions.**
- **Combustion of Fossil Fuels**: This results in **CO_2, sulphur and particulates** being released into the atmosphere. If combustion occurs in a hot engine, **NO_2** will also be released (also a greenhouse gas) as nitrogen from the air fuses with oxygen.

The amount of carbon is measured in **gigatonnes** (Gt) or **petagrams** (Pt). It is estimated that burning fossil fuels has added more than **180 Gt** of carbon to the atmosphere.

Increasing levels of greenhouse gases can affect the **planet's climate**, which can have implications for the water cycle, biomes and wildlife living on Earth.

Implications of The Enhanced Greenhouse Effect

Thawing of Tundras and Glaciers

Warmer temperatures cause **melting**, which is clearly bad for all cold environments.

- Permafrost melts
- Glaciers retreat
- Alpine environments thaw for longer summers

This melting causes further issues:

- Local **floods** near glaciers
- Global floods if major ice sheets and glaciers melt, causing sea level rises
- Disruption to flora and fauna that are adapted to the environment
- **CO_2** is released into the atmosphere that is **stored** in ice sheets and permafrost
- **Albedo effect** is lessened due to less ice sheets

Temperature

The amount of **solar energy** reaching the Earth varies depending on location, and is the main factor in determining climate temperatures. **Solar intensity** is more intense at the equator, and reduces as you travel towards the poles.
The **Albedo Effect** will also determine the temperature of a location. Snow **reflects** solar radiation whereas dark forests **absorb** the most solar radiation.

Climate and Weather

Rising levels of CO_2 in the atmosphere are believed to be the main contributor to an increase in **average global temperatures**.
However, increases may vary:

- In Europe, average temperatures are expected to increase more than the global average.
- The largest increases are expected in Eastern and Northern Europe during winter and Southern Europe during summer.
- Annual precipitation is expected to increase in Northern Europe but decrease in Southern Europe.

Extreme weather events and hydro-meteorological hazards are likely to increase in severity and frequency if temperatures rise due to Climate Change:

- If land and sea surface temperatures continue to rise, the **period between ENSO cycles** (currently every 2-3 years) could **decrease**. This would lead to more periodic unusual climates for both South America and Australia.
- Increasing average global temperatures would increase rates of evaporation, which could lead to potential **droughts** and **increasing water scarcity**.
- However, for some locations, a rise in average temperatures will lead to more convectional rainfall and **enhanced tropical cyclone or depression intensity**. This in turn will cause more intense and periodic flooding.

Ecosystems

Ecosystems help to regulate the carbon and hydrological cycles. **Global Warming** could impact the functioning of ecosystems. The two **biomes** most at risk are **the Artic** and the **coral ecosystems.**

Species with low population numbers are already at **high risk**. There is already evidence showing that there will be change in species' population size, timing of reproduction and migration.

Marine organisms are also at risk. They are threatened with **low oxygen levels** and high rates of **acidification**. The impact on coastal ecosystems and low lying areas of **sea levels rising** could continue.

Uncertainty in Predictions:

It is very **difficult to predict** future emission levels and so scientists use various scenarios to show projected greenhouse gas concentrations. There are several **uncertainties** in estimating future Climate Change, but they have identified several **tipping points and feedback mechanisms** that scientists believe would accelerate change. A climate tipping point is a **critical threshold**; when this threshold is reached, small changes in the global climate system can transform a stable system irreversibly.

- **Population change** – Increasing affluence in emerging economies means that that by 2050 there could an additional 1 billion consumers which could lead to more emissions due to more energy consumption.
- **Technology and Globalisation** - Increased globalisation leads to more traveling and transportation of goods which could mean more emissions. However, technological advancements may compensate and decrease emissions created by the interconnected world.
- Peat is the **accumulation** of partly decayed vegetation, which stores a large amount of carbon. As peat warms up, its rate of **decomposition increases**, and so greenhouse gases are emitted.
- When **permafrost melts**, trapped carbon is released into the atmosphere as CO_2 and methane which **increases greenhouse gas concentrations** in the atmosphere. This leads to higher temperatures and further melting of ice. The **Siberian permafrosts** are one of the largest stores of methane, which would vastly accelerate Global Warming if released.
- The melting of Northern ice sheets releases large amounts of **fresh water** into the ocean which is less dense and has low salinity. This will **disrupt the thermohaline circulation** of water, affecting the circulation of climates for Europe and America.

Impacts of Climate Change:

It is thought that climate change will affect industrial sectors and economic productivity, especially for agriculture.

Farming is most susceptible to changes in weather and climate, since the growth of their crops depends on the conditions they are grown in.

For semi-arid climates, Climate Change is likely to increase average temperatures and so increase the rate of evaporation of water moisture. This will reduce plant growth and increase the soil's vulnerability to erosion.
Farmers' techniques will need to adapt to the changing climates. Some farmers may lose their ability to farm, if the soils and environment become unfavourable: hot, dry, arid. However, some farmers may continue to farm with improved irrigation and strategic crop planning.

Governing Climate Change

National and international efforts to combat and adapt to Climate Change have varying levels of success.

National efforts may not be possible depending on the cost of engineering schemes, technology and knowledge, level of development. However, national efforts tend to have a small impact on emissions. International efforts can have a larger impact on global emissions, and cooperation between countries tend to motivate and hold accountable countries who don't participate. However, very large scale collaborations are hard to organise.

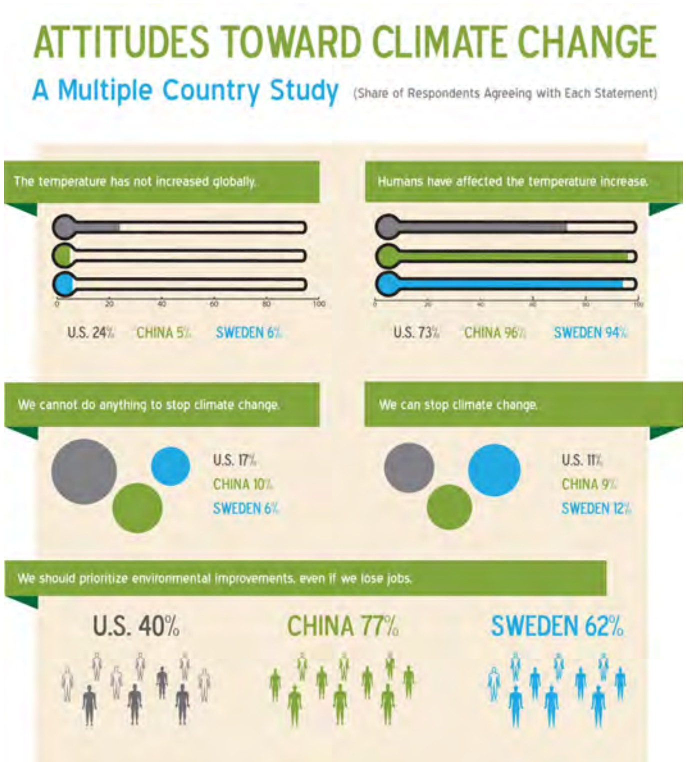
UN Climate Change Conferences

Finally, the UN also aims to encourage the protection of the environment and the reduction of greenhouse gas emissions. The changing attitude of many state governments has been caused by several important conferences:

- **Montreal Protocol** - Finalised in 1987. Aimed to stop the use of CFCs and Halons, both highly damaging to the ozone layer.
- **The Kyoto Protocol** - Held in 1997. Aimed to generally reduce greenhouse gas emissions
- **The Paris Agreement** - Held in 2015. Highest number of signatures/ states participating to date. However, key emitters such as the USA have withdrawn since.

Environmental Alliances

Intergovernmental Panel on Climate Change (IPCC) - This organisation was established by the UN in 1988. Its aims are to stabilise greenhouse gas emissions and reduce the harm humans are doing to the environment. Its success can be argued, since many governments still pollute and are not held accountable by the many policies and protocols they may have signed.



Varying Attitudes to Global Warming

- Some countries have **different attitudes** to global warming and climate change.
- Some don't believe that climate change is occurring, since they **dispute** whether greenhouse gas emissions are the cause of average temperature change.
- Some countries **don't feel accountable** for their emissions, so won't reduce their emissions or adapt their farming practices. *Source: peakresources.blogspot.com*