AQA GCSE GEOGRAPHY UNIT 1

Living with the Physical Environment Exam

REVISION RESOURCE 1

SECTION A

The Challenge of Natural Hazards

Natural Hazards

Natural Hazard – A natural event that has a huge **social** impact.

Examples:
Volcanic eruptions
Earthquakes
Storms
Tsunamis
Landslides
Floods

Hazard Risk – the chance of being affected by a natural event.

For example, those who live close to rivers may be at risk from flooding.

Note: An event is only a natural hazard if it poses **threat** to humans. If an event happens in an **uninhabited** area then it is **not** considered a natural hazard.

Factors that Affect Risk

Urbanisation
Densely-populated urban areas are at great risk from natural events (e.g. San Francisco).

Climate Change
Global warming lead to the atmosphere having more energy and higher-intensity storms. Some areas of the world will become drier whilst others will become wetter.

Farming
Floodplains are very fertile so are excellent for farming. People may choose to live there, putting their lives at risk (e.g. by River Ganges in Bangladesh)

Poverty
Poverty may force some people to live in areas of risk. E.g. in Lima, Peru a shortage of housing has led to building on unstable slopes prone to landslides.

Tectonic Plates

The Earth's crust is split into 100km thick plates.

Types of Crust:

1) **Oceanic crust –** thin and dense
2) **Continental crust –** thick and less dense

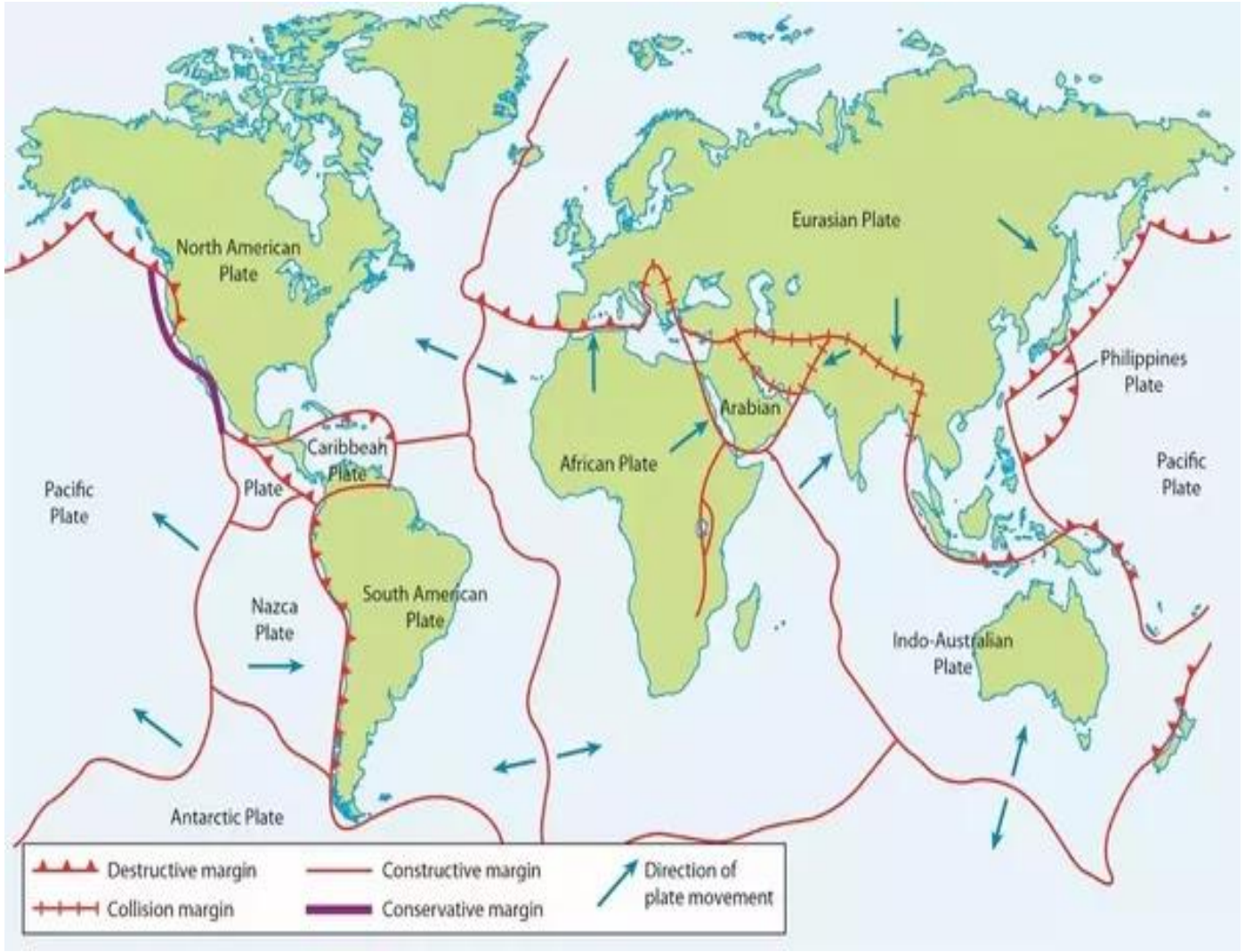
Plates move due to **convection** (heat) currents from the Earth.

Constructive plate margin –

a) Plates move apart
b) New crust is formed as magma rises to surface

Destructive plate margin

a) Plates moving towards each other
b) Oceanic plate by **subduct** (sink) beneath continental plate
c) Gravity pulls oceanic plate into **mantle**, dragging plate away from constructive margin



Tectonic Hazards

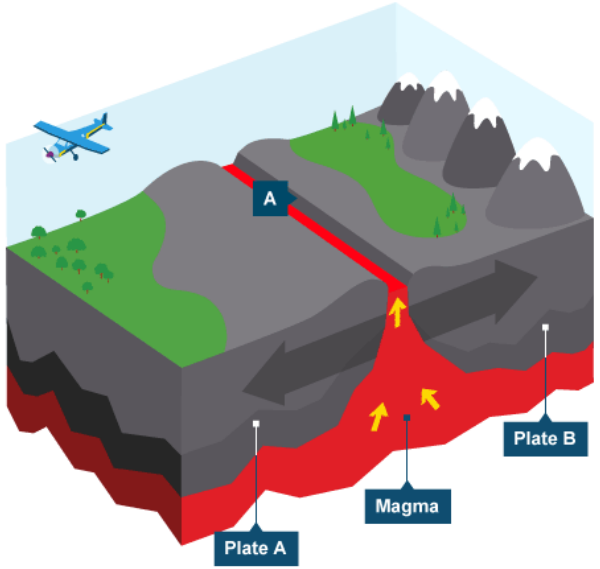
Plate Margins

Plate Margin – The border between two **tectonic plates**.

Constructive Margin

Where two plates are **moving apart**.

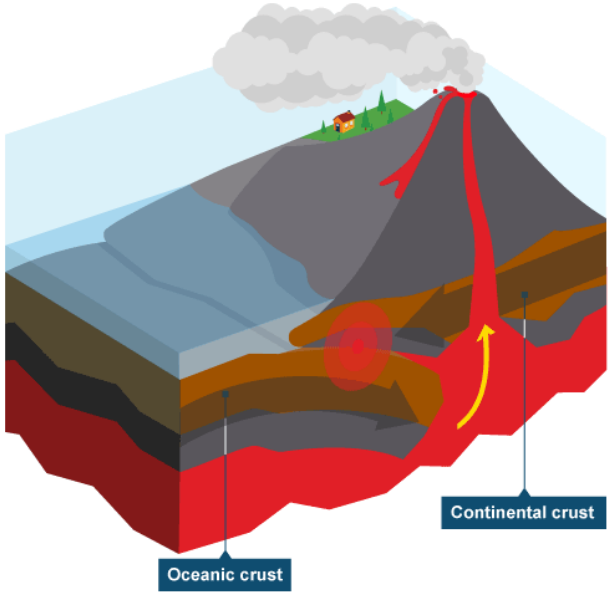
Volcanoes are formed as magma wells up to fill the gap, and eventually **new crust is formed**.



Destructive Margin

Where two plates are **moving towards each other**.

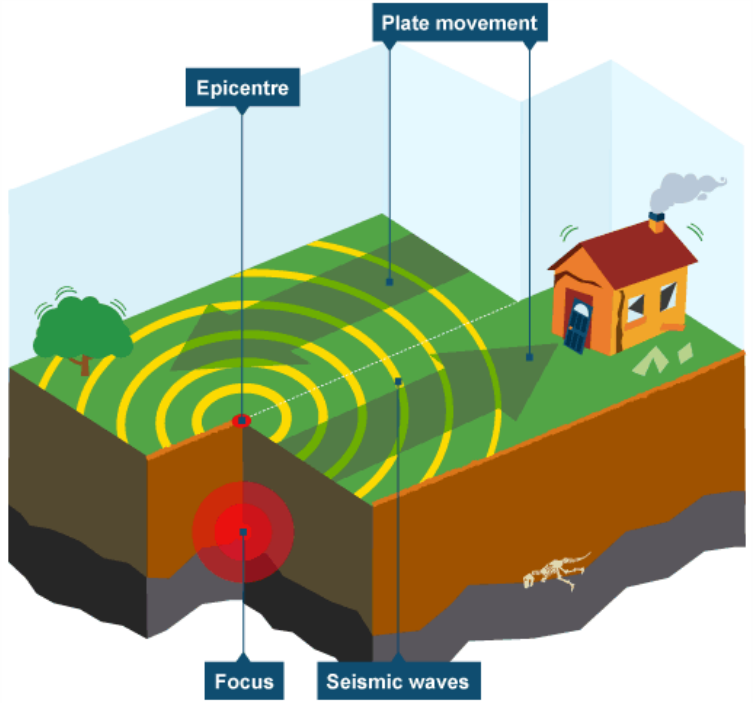
The **oceanic plate** is forced under the lighter **continental plate**. Friction **causes melting** of the oceanic plate and may trigger earthquakes. Magma rises up through cracks and **erupts** onto the surface.



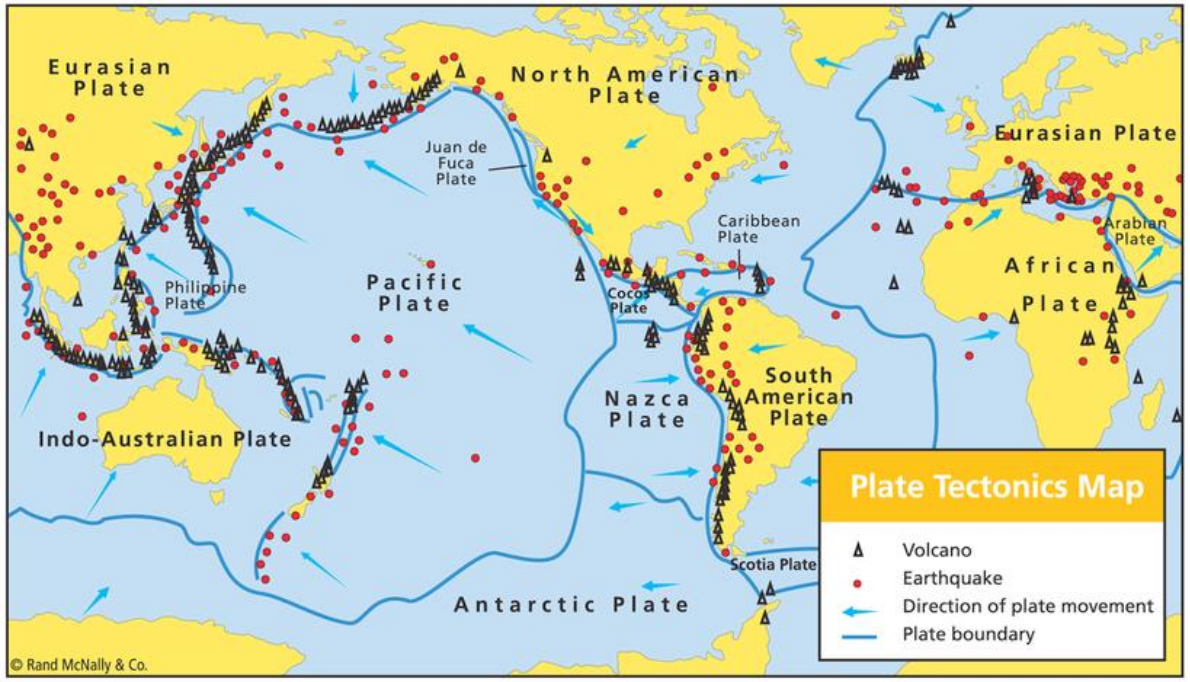
Conservative Margin

Where two plates are **moving (rubbing) past each other.**

Friction is eventually overcome and the plates slip past in a **sudden movement**. The shockwaves created produce an **earthquake**.



Distribution of Volcanoes and Earthquakes



Earthquakes mostly occur on the margins of **tectonic plates**. The plates move, causing great amounts of pressure to build and be released.

Some earthquakes are caused by **human activity** (e.g. mining) so may not occur on plate margins.

Earthquake – Sudden and violent period of ground shaking.

Volcano – A large landform usually formed over a long period of time by a series of eruptions.

Most volcanoes occur in **belts** that follow plate margins.

The most well-known is called the **'Ring of Fire'** around the edge of the Pacific Ocean.

Volcanoes are fed by **magma** which rises to the surface at **constructive and destructive plate margins**. They also form at thin areas if the Earth's crust where **magma** can break through.

Effects of Earthquakes

Primary Effects – Caused by the ground shaking.

Examples:
Deaths and injuries
Damage to buildings and roads
Loss of access to power and water

Secondary Effects – Are the result of primary effects.

Examples:
Fires
Landslides
Tsunamis

Chilean Earthquake 2010

Primary Effects of Chilean Earthquake

1. 5000 deaths and 12,000 injuries
2. Destroyed: 220,000 homes, 4500 schools, 53 ports and 56 hospitals
3. Santiago airport badly damaged
4. Most of Chile lost power, water and communication
5. Estimated damage of $30billion

Secondary Effects of Chilean Earthquake

1. 1500km of roads damaged by landslides caused by the earthquake
2. Many remote communities cut off due to damaged roads
3. Lots of coastal towns damaged by tsunami waves
4. Other Pacific countries hit by tsunami waves
5. Fire at a chemical plant in Santiago

Effects of Earthquakes

Indicator	Chile	Nepal	UK
GDP (wealth)	38th out of 193 countries	109th out of 193 countries	6th out of 193 countries
HDI (development)	41st out of 193 countries	145th out of 193 countries	14th out of 193 countries

Nepalese Earthquake 2015

Primary Effects of Nepalese Earthquake

1. 9000 deaths and 20,000 injuries
2. 8 million people affected (1/3 Nepal's population)
3. 3 million left homeless
4. Electricity, water supplies, sanitation and communications affected
5. 1.4 million needed food, water and shelter in the weeks following the earthquake
6. 50% of shops destroyed, affecting food supplies
7. Cost of damage was $5billion

Secondary Effects of Nepalese Earthquake

1. Landslides and avalanches triggered by the earthquake blocked roads
2. Avalanches killed 19 people on Mount Everest
3. Landslide blocked the Gandaki River, causing flooding
4. Earthquake happened on land so no tsunami triggered

Responses to Earthquakes

Immediate Responses – Search and rescue, keeping survivors alive by providing food, medical care, water and shelter.

Long-term Responses – Rebuilding with the aim of returning peoples' lives back to normal whilst reducing further risk.

Comparing Responses

Earthquakes in Chile are common and so local communities and the government are well-prepared. Chile also had money to support people and to rebuild.

Earthquakes are not uncommon in Nepal and scientists have identified an earthquake pattern. However, little had been done to prepare the Nepalese people when the earthquake struck.

Chile – Immediate Responses

1. Quick action by emergency services
2. International help to supply field hospitals, satellite phones and floating bridges
3. Temporary repairs to Route 5 highway within 24 hours so aid could be transported
4. Power and water restored within 10 days to 90% homes
5. National appeal raised $60 million to build 30,000 emergency shelters

Chile – Long-term Responses

1. Housing reconstruction plan launched 1 month after by the government which helped 200,000 affected households
2. Strong economy could be rebuilt without much foreign aid

Responses to Earthquakes

Nepal – Immediate Responses

1. Search and rescue teams, water and medical support arrived quickly from other countries
2. Helicopters rescued many from Mount Everest and delivered supplies to villages cut off by landslides
3. 500,000 tents needed to shelter the homeless
4. Financial aid from many countries
5. Field hospitals set up to support overcrowded hospitals
6. 300,000 migrated to the capital to seek shelter with friends and family
7. Satellites mapped damaged areas

Making comparisons

Nepal is less developed and less wealthy that Chile.

Nepal relied heavily on foreign aid.

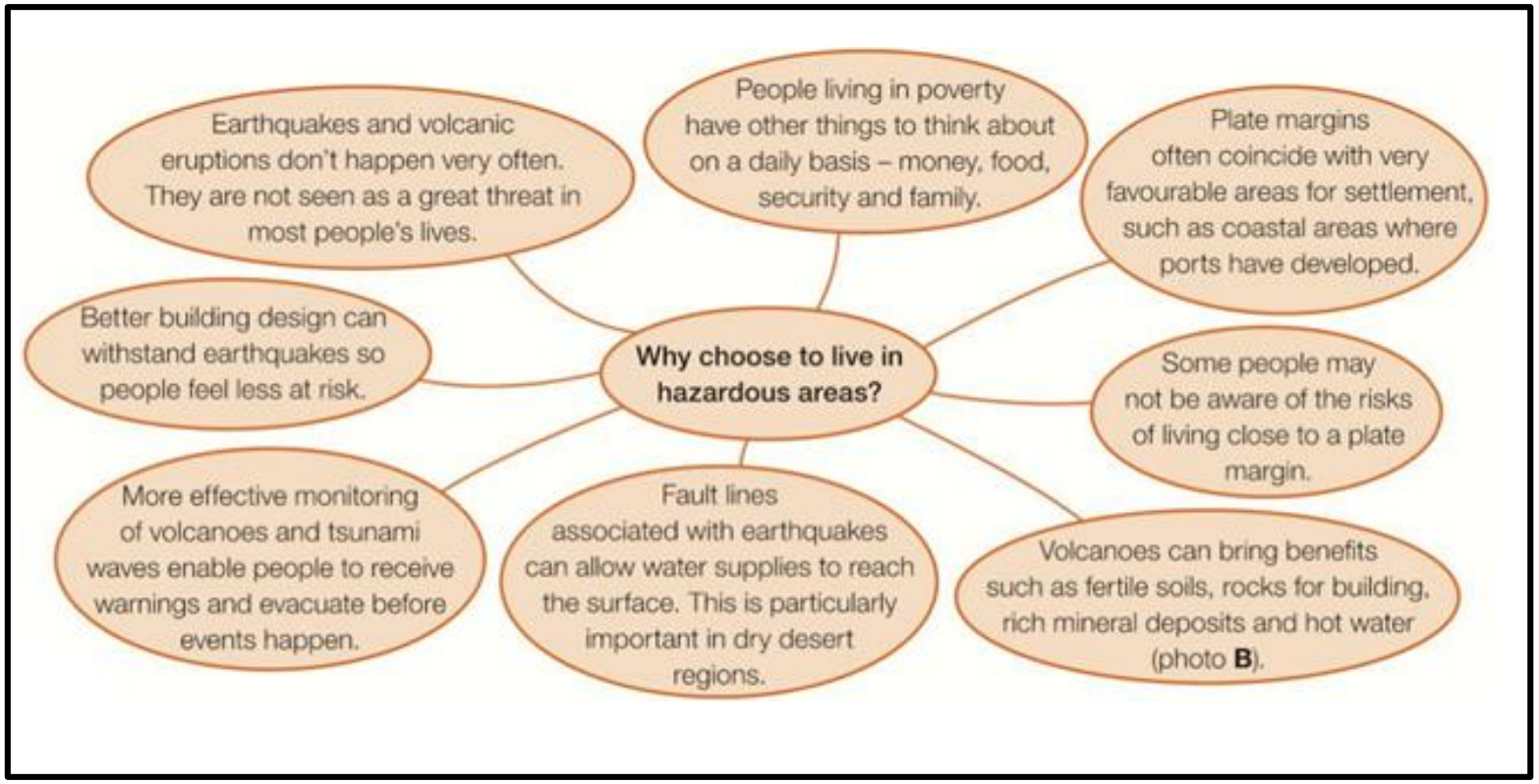
Chile had the resources and money to prepare for the earthquake and act immediately to it.

Nepal lacked the resources and money to prepare for and respond to the earthquake effectively.

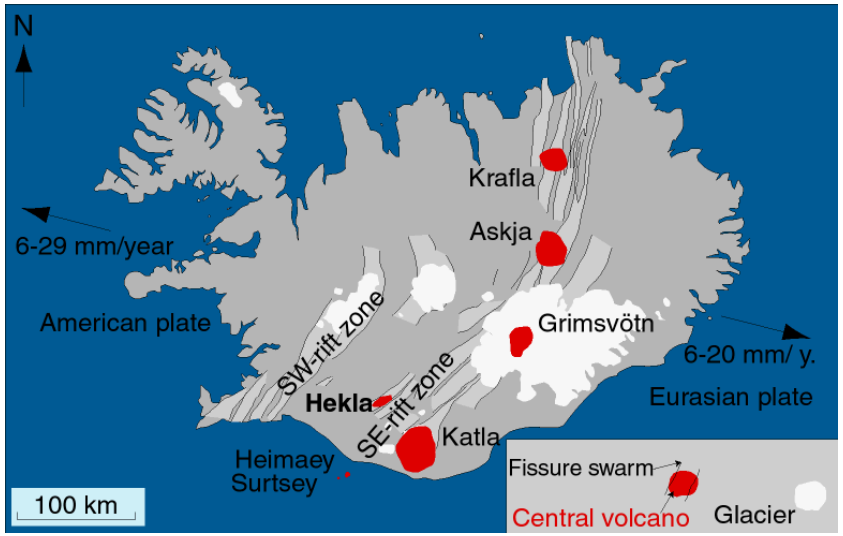
Nepal – Long-term Responses

1. Roads repaired and landslides cleared
2. Lakes formed by landslides were drained to avoid flooding
3. Thousands of homeless people rehomed
4. 7000 schools rebuilt or repaired
5. Stricter building codes
6. June 2015: Nepal held international conference to seek technical and financial support
7. Tourist sites reopened to bring in income
8. Repairs to Everest base camp and trekking routes

Why choose to live in tectonic hazardous areas?



Case Study - Iceland



Iceland lies on the Mid-Atlantic Ridge, a constructive plate margin.

There are several **active volcanoes** on the island and there is an eruption every 5 years.

Although tectonic activity does pose a threat, many consider it **low risk** due to scientific monitoring.

Hot water from Earth's crust provides heat for nearly 90% buildings in Iceland.

Iceland's landscape draws many tourists which means jobs for locals.

Geothermal energy used to generate 25% of Iceland's electricity.

Volcanic rocks are used in road and building construction.

Naturally occurring hot water is used to heat greenhouses and swimming pools.

Reducing the Risk from Tectonic Hazards

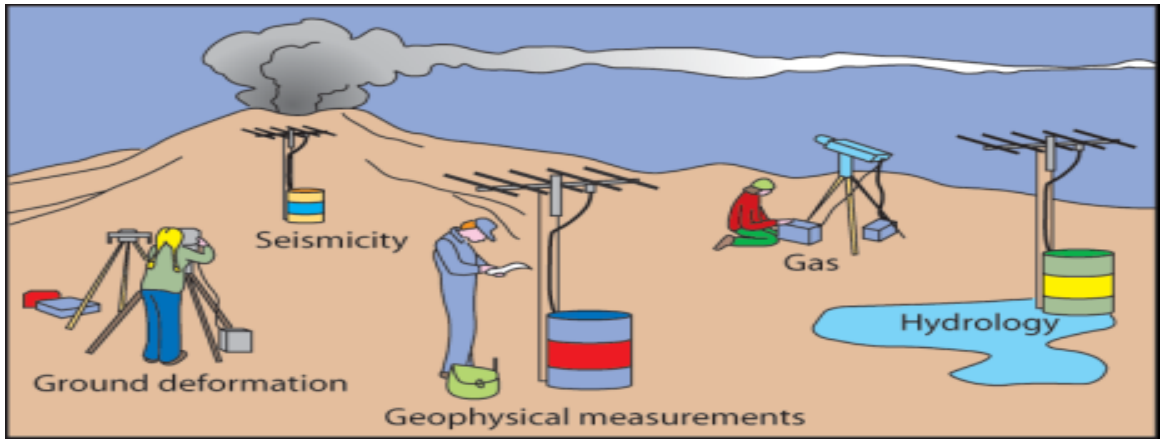
Remember the 4 management strategies:

Monitoring – Using **scientific equipment** to detect warning signs of tectonic hazards.

Prediction – Using **historical evidence** and **monitoring** to predict where an when a tectonic hazards.

Protection – Designing buildings that will withstand tectonic hazards.

Planning – Identifying and avoiding places most at risk.



Monitoring – Volcanoes

All of the world's volcanoes are monitored by scientists. If an eruption seems likely then warnings can be issued and evacuation can take place.

Methods of monitoring volcanoes

1. **Remote sensing –** satellites detect heat and changes to volcano's shape.
2. **Seismicity** – seismographs record earthquakes.
3. **Ground deformation –** changes to the shape of the volcano are measured using laser beams.
4. **Geophysical measurements –** detect changes in gravity as magma rises to the surface.
5. **Gas –** Instruments detect gases that are released as magma rises.
6. **Hydrology –** Measurements of gases dissolved in water.

Reducing the Risk from Tectonic Hazards

Prediction – Volcanoes
This is all based on **scientific monitoring**.

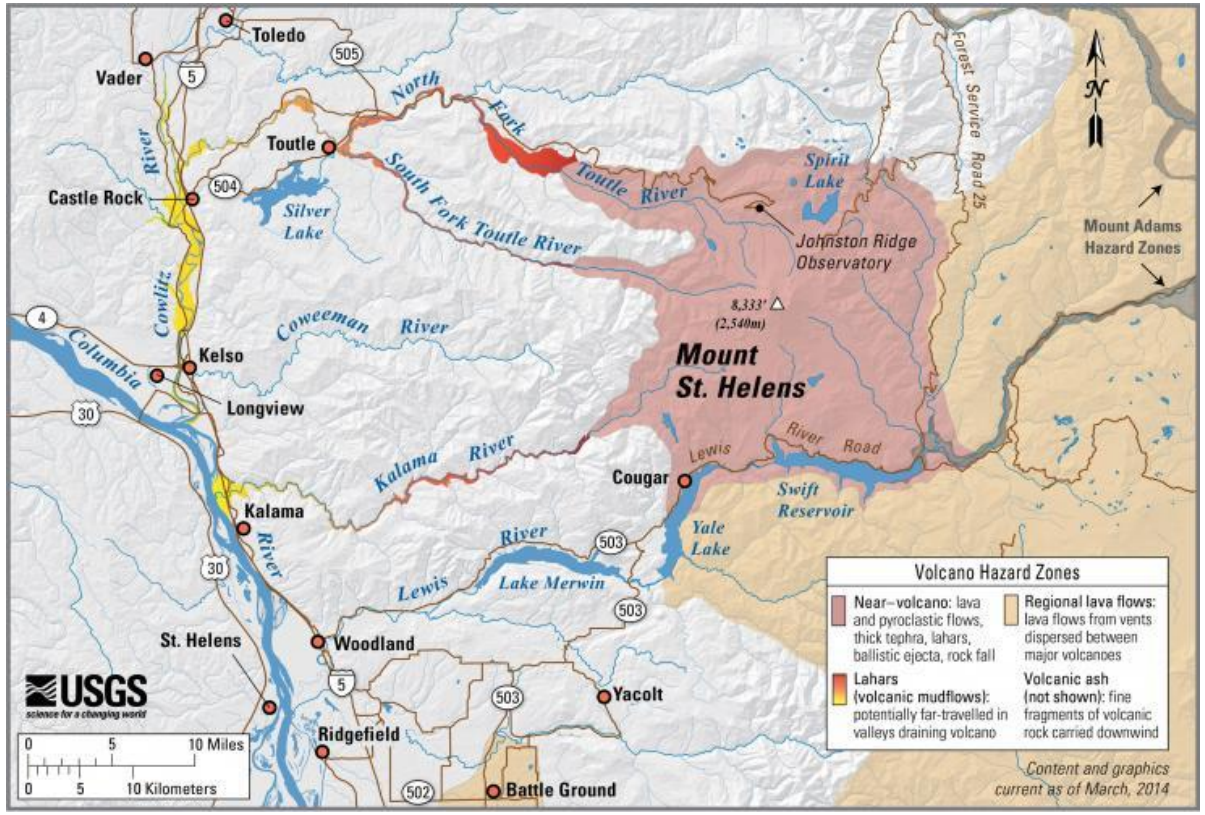
In 2010 an increase in earthquake activity allowed scientists to predict when the **Eyjafjallaökull volcano** in Iceland was going to erupt.

Protection – Volcanoes
Often, little can be done to protect people and property from volcanoes due to their sheer **power**.

It is possible to use earth embankments or explosives to **divert** lava away from properties. This has been done on the slopes of **Mount Etna, Italy**.

Planning – Volcanoes
Hazard maps have been produced for world's most dangerous volcanoes, showing likely areas to be affected.

Hazard maps can be used to **restrict land usage** and to identify evacuation areas.



Volcano Hazard Map for Mount St. Helens, USA

Reducing the Risk from Tectonic Hazards

Monitoring – Earthquakes
Earthquakes generally occur **without warning**.

Some evidence in **change of water pressure**, ground deformation and minor tremors prior to an earthquake.

Scientists are yet to discover reliable ways to monitor and predict earthquakes.

Prediction – Earthquakes
Impossible to make accurate predictions due to lack of warning signs.

Scientists studying **historical records** of earthquakes have **identified locations** at greatest risk.

Planning – Earthquakes
Maps can be produced to show the effects of an earthquake or identify areas most at risk.

High-value land uses (e.g. hospitals) can be protected in vulnerable areas.

Protection – Earthquakes
The **main way** to reduce risk from earthquakes.

It is possible to construct building and bridges to **resist** ground shaking.

In Chile, **new buildings** have reinforced concrete columns strengthened by a steel frame.

Regular earthquake **drills**.

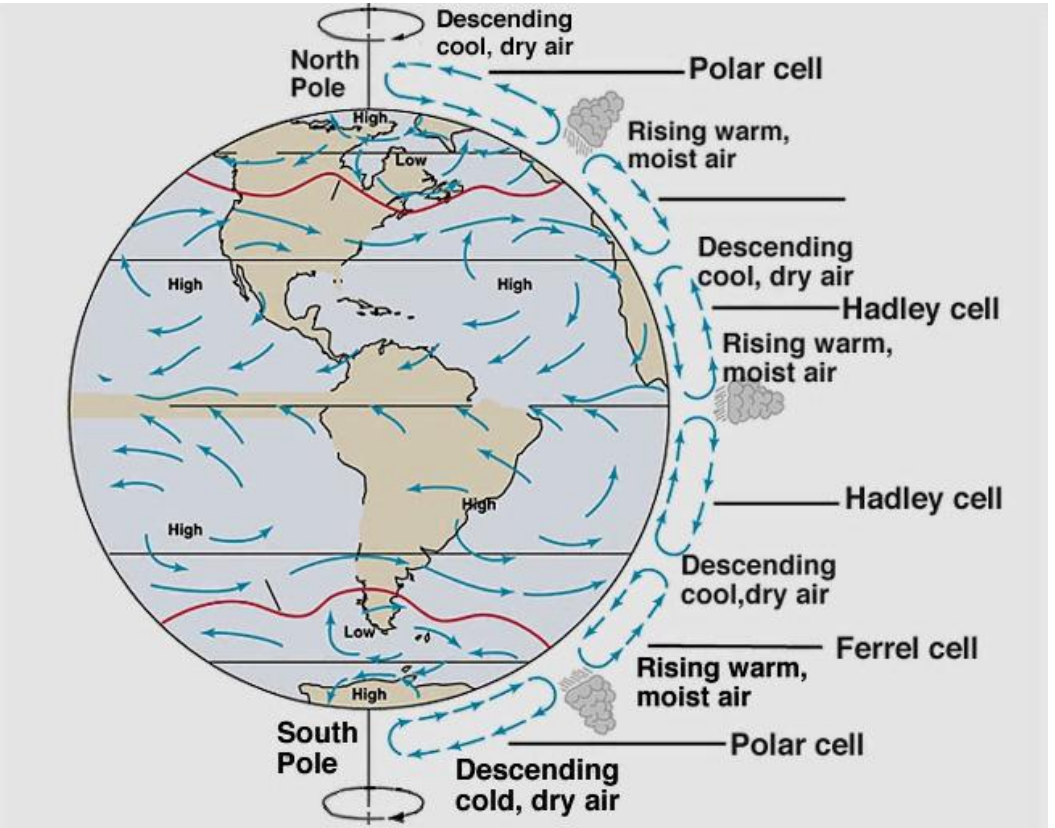
Tsunami walls at coast and around important buildings.

Global Atmospheric Circulation

Global Atmospheric Circulation – Worldwide system of winds that transports heat from the equator to polar regions.

How does it work?

1. A number of circular air movements called cells join together to form overall circulation.
2. Air that sinks towards the Earth's surface forms areas of high pressure. Winds on the ground move outwards from these areas.
3. Air that is rising from Earth's surface forms areas of low pressure. Winds on the ground move towards these areas.
4. Winds on the ground are distorted by Earth's rotation.
5. Surface winds transfer heat and moisture from one place to another.
6. Patterns of pressure belts and winds are affected by seasonal changes. Tilt and rotation of Earth causes changes in position of the overhead Sun. These seasonal changes cause pressure belts and winds to move north during our summer and south in our winter.



Visual representation of global atmospheric circulation.

How does global circulation affect weather?

Circulation cells, pressure belts and surface winds affect weather around the world.

For example, **trade winds** in the tropics are responsible for driving **tropical storms** across these regions.

Hot and Dry in the Desert

Most of the world's deserts are located 30° north and south of the equator. Here, there is a belt of **high pressure** so air does not rise. This means there are **few clouds** and little rainfall.

Cloudy and Wet in the UK

The UK is close to the **boundary** of cold polar air moving down from the north and warm sub-tropical air moving up from the south.

The boundary between these 2 air masses is **unstable**. Rising air cools, condenses and forms clouds and rain.

Hot and Sweaty at the Equator

Air rises at the Equator and there is a **low pressure** belt. This part of the world is very hot as the Sun is overhead.

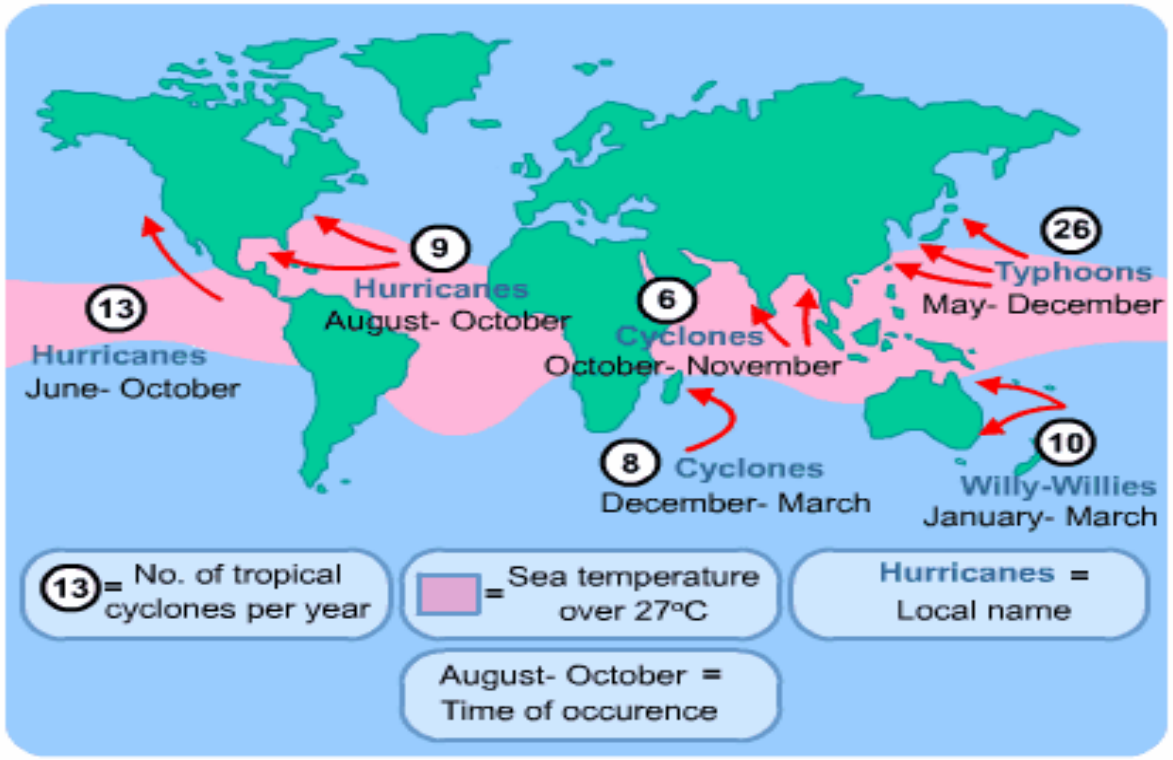
Equatorial regions experience hot, **humid** conditions where it is often cloudy with lots of rainfall. **Tropical rainforests** are found here.

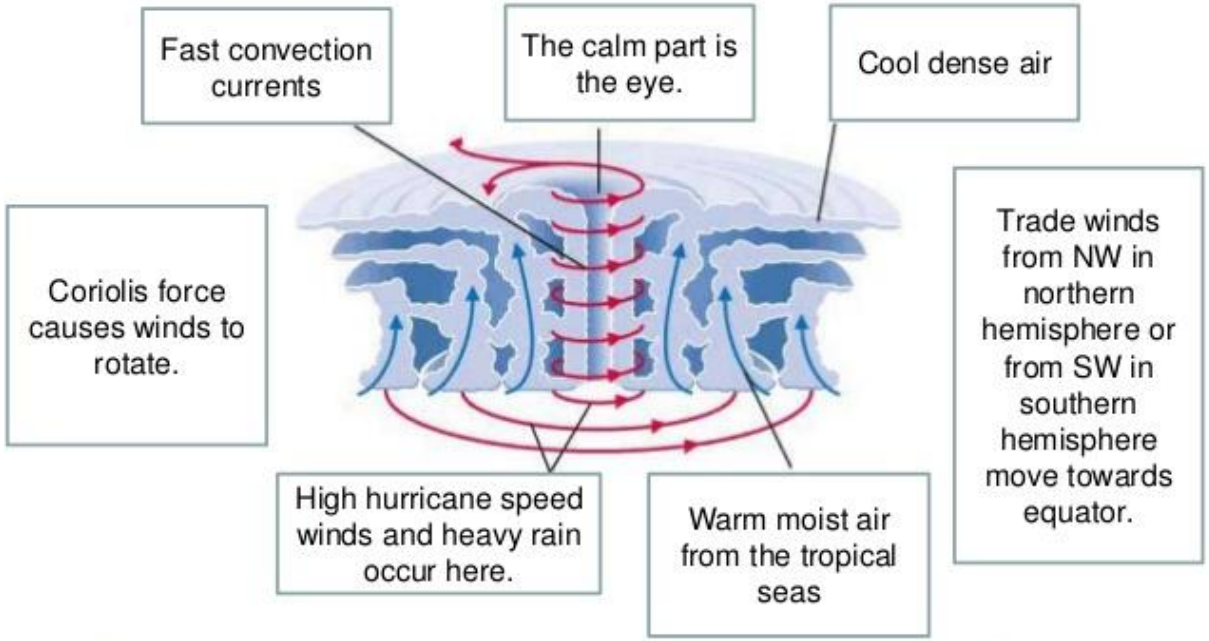
Tropical Storms

Tropical Storm – A huge storm that develops in the Tropics.

Also called:
Cyclones
Hurricanes
Typhoons

Conditions needed:
1. Warm ocean (above 27°C
2. 5-15° north and south of Equator
3. Intense heat that makes air unstable





Tropical storms form over oceans with temperatures of +27˚C and sea depth of at least 60metres where water can evaporate and fuel the storm.

Weather Hazards

This hurricane started in the middle of the Pacific Ocean, latitude about 20'C North. The wind shear was quite low, the sea temperature was very high, it was very humid in low-middle low areas.

The perfect conditions for a hurricane to form.

Water vapor rises from the warm air of the sea. It releases it's heat into the air and it is pulled into a column of clouds. More and more layers form, which soon turns into thunderclouds.

Tropical Disturbance

As the thunderstorm grows larger, the air starts to cool and become unstable. Then, the air on top of the clouds gets warmer, making the winds move away, creating more thunderstorms. The storms grow faster, before spinning around in circles at 25-38mph.

Tropical Depression

The wind speeds go above 39mph, the winds blow faster, circling around the eye. It spins counterclockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere because of what's called the Coriolis effect.

Tropical Storm

The wind speeds race over 74mph, it's 50,000 feet high and 125 miles wide. The eye is now 5-30 miles wide. Storm surge sometimes happens when it hits land because mounds of ocean water pile up in the eye. It weakens when it reaches land due to loss of heat.

Tropical Cyclone

This is Hurricane Adrian/Chun Wa! A monster of the seas!

Formation of a Tropical Storm

Climate Change and Tropical Storms

Climate Change – A change in global or regional climate patterns.

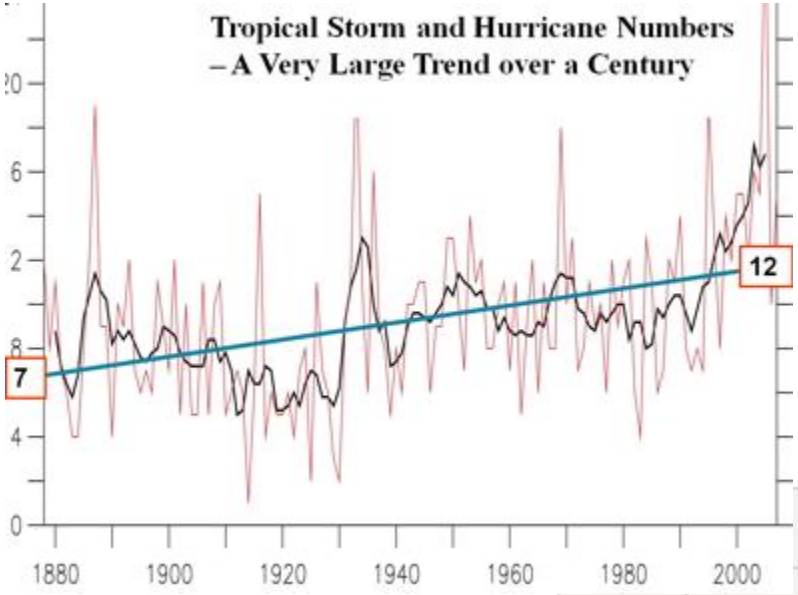
There is **strong scientific evidence** that global temperatures have risen over the past few decades.

Distribution

- Sea surface temperatures have increased by 0.25-0.5°C over the last few decades.
- As a result, tropical storms may affect areas currently outside the hazard zone.
- Hurricanes could become more powerful

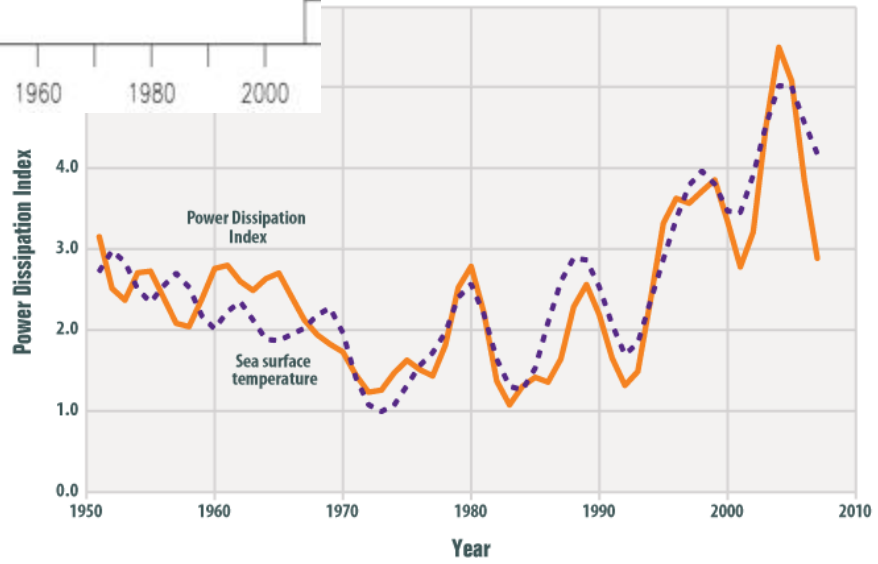
Case Study – Hurricane Catarina (2004)

- Brazil hit by **Category 2** hurricane for the first time in that region.
- Usually has strong wind sheer and cold ocean.
- March 2004 had **unusually high** sea surface temperatures in that region.



The frequency of tropical storms has increased in the last century.

As the sea surface temperature increases, so does the intensity of tropical storms.



Case Study – Typhoon Haiyan

In November 2013 Typhoon Haiyan, a **category 5 storm**, hit the Philippines. It was one of the strongest storms ever recorded.

Huge areas of coastline and several towns were **devastated** by winds of up to 170mph and waves of up to 15m.

Primary Effects	Secondary Effects
1. 6300 killed (most drowned in the storm surge)	1. 14 million affected with many left homeless
2. 600,000 displaced and 40,000 homes damaged or destroyed	2. 6 million lost source of income
3. Tacloban airport badly damaged	3. Flooding caused landslides and blocked roads so aid was cut off to remote communities
4. 30,000 fishing boats destroyed	4. Power supplies cut for up to a month
5. Crops and power lines destroyed	5. Shortages of food, water and shelter led to outbreaks of disease
6. 400mm rain caused widespread flooding	6. Looting and violence
	7. Hospitals, schools and shops destroyed affecting jobs and education

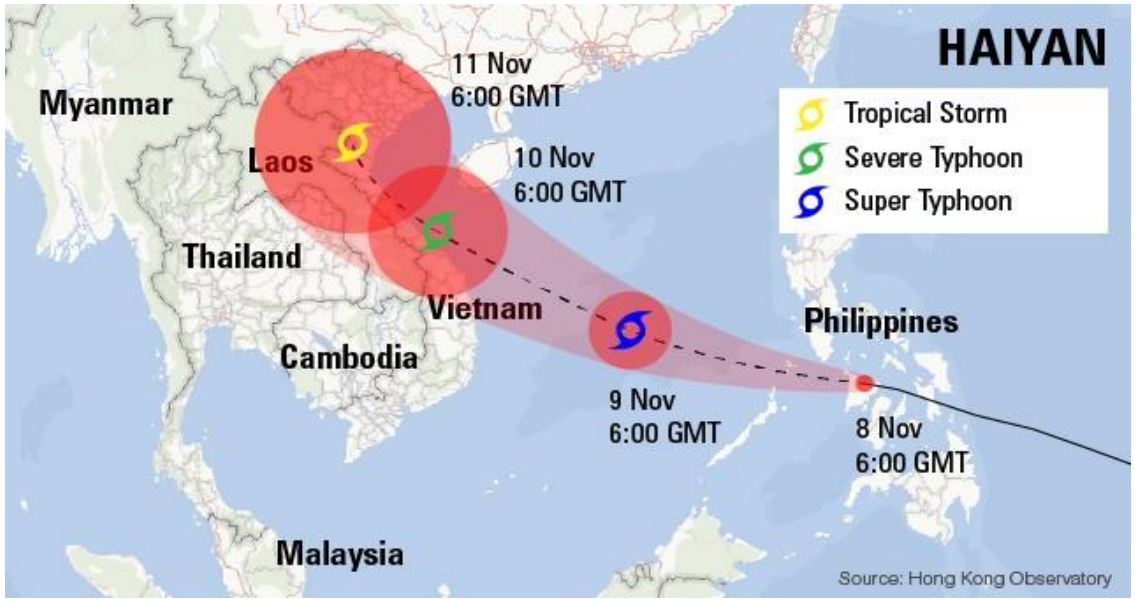
Immediate Responses

- **International aid** provided food, water and shelter
- US aircraft assisted with aid delivery and search and rescue
- 1200 evacuation centres to **help homeless**
- French, Belgian and Israeli field hospitals set up

Long-Term Responses

- UN and HICs **donated** financial aid, supplies and medical support
- Rebuilding of roads, bridges and airport
- '**Cash for Work**' programme to clear debris
- Rice farming and fishing quickly re-established
- **NGOs**, like Oxfam, supported replacement of fishing vessels
- Thousands of homes built away from areas at risk from flooding
- **Cyclone shelters** built to accommodate people evacuated from coastal areas

Reducing the Effects of Tropical Storms



Predicted track of Typhoon Haiyan

Monitoring and Prediction

Technology makes it possible to predict and monitor tropical storms. In the North Atlantic there are 2 levels of warning:

1) **Hurricane Watch** – advises that hurricane conditions are possible
2) **Hurricane Warning –** advises that hurricane conditions are expected and people should take action

Planning

- **Unrealistic** to expect millions of people to stop living and working in high-risk areas
- Many people **rely** upon fishing and tourism to earn money
- **HICs** – large urban centres have been constructed in vulnerable areas
- Planning mostly about raising community and individual **awareness**
- People need to know dangers and be able to respond
- USA – **National Hurricane Preparedness Week**

Protection

- Windows, doors and roofs **reinforced** to withstand tropical storms
- **Storm drains** constructed in urban areas to prevent flooding
- Sea walls built to protect key properties from storm surges
- Houses close to coast constructed on **stilts** so storm surge will pass beneath
- **Bangladesh –** 2000 cyclone shelters built

Weather Hazards in the UK

Weather – Day-to-day conditions of the atmosphere.

Weather hazards are extreme weather events. Even though the UK has **moderate** weather, it still experiences extreme weather.

Examples

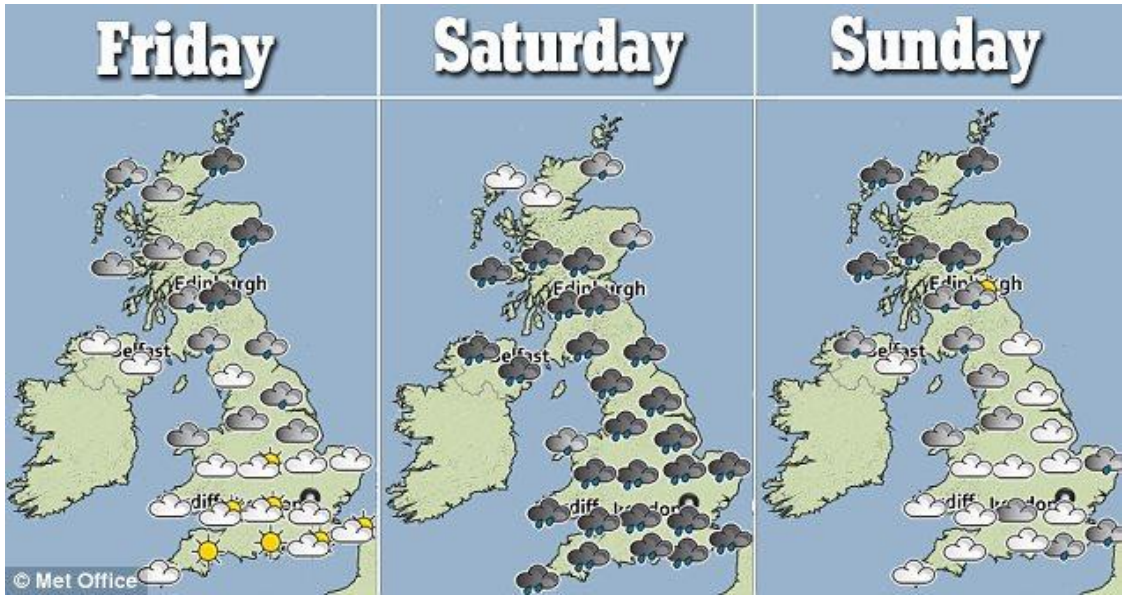
Thunderstorms – can result in flash flooding

Prolonged rainfall – can lead to river floods

Drought and Extreme Heat – rivers and reservoirs become low and affect water supplied. Elderly at risk from heatwaves.

Heavy snow and extreme cold – less common in recent years

Strong Winds – can cause disruption to power supplies and damage from fallen trees



Why does extreme weather occur in the UK?

The UK is the **meeting point** of several different types of weather from different directions.

This is why we have **widely varying** weather and why we are prone to extreme weather events.

Case Study – Somerset Floods

Somerset, UK

Somerset is a county in **south-west** England. There are large areas of **low-lying land** and wetlands. The area is drained by several rivers which flow to the Severn Estuary.

Flooding has occurred naturally here for centuries. More people are at risk now as the land has been **developed** for farming and housing.

Causes

1. Was the **wettest January** since records began in 1910.
2. 350mm of rain fell in January and February **(100mm above average).**
3. High tides and storm surges swept water up rivers and **spilled over** river banks.
4. River was **clogged** with sediment.

Social	Economic	Environmental
1. 600 houses flooded 2. 16 farms evacuated 3. Residents evacuated to **temporary accommodation** for months 4. Villages **cut off** affecting daily lives 5. Power supplies cut off	1. £10 million of damage 2. 14,000 hectares of **agricultural land** under water for 3-4 weeks 3. Over 1000 livestock evacuated 4. Local roads cut off by floods 5. Bristol to Taunton railway line closed a Bridgwater	1. Floodwaters heavily **contaminated** with sewage, oil and chemicals 2. Huge amount of debris had to be cleared 3. Stagnant water that had collected for months had to be **re-oxygenated** before being pumped back into rivers

Case Study – Somerset Floods

Somerset, UK

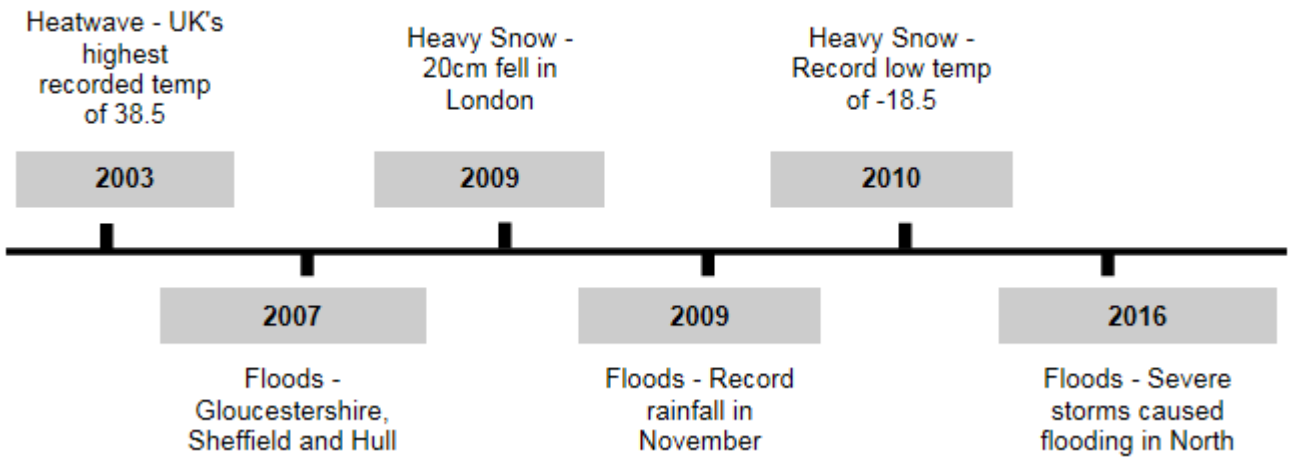
Immediate Responses

1. Villagers cut off by floods used **boats** to go shopping or go to school
2. Local community groups and volunteers gave **support**

Long-term Responses

1. £20 million **Flood Action Plan**
2. 8km of Rivers Tone and Parratt were **dredged** to increase river channel capacity
3. Road levels **raised** in some places
4. Vulnerable communities will have flood **defences**
5. River banks raised and strengthened
6. More **pumping stations** to be built

Is the UK's weather becoming more extreme?



Whilst there have been many extreme weather events in the UK across history, this is happening **more frequently** than in the past.

The timeline shows some of the extreme weather events the UK has experienced since 2000.

Why?

Scientists are **linking** increasing extreme weather events with a warming world.

More energy in the atmosphere could lead to more intense storms.

Global atmospheric circulation may be affected, bringing floods to dry regions and heatwaves to cooler areas.

'Stuck' Weather Patterns?

Weather systems in the UK cross mainly from **west to east**, driven by winds from the **jet stream**.

The **jet stream** moves north to south but can **'stick'** in one position, resulting in a long period of time with the same weather (e.g. rain).

Scientists have suggested that weather patterns are becoming stuck for longer periods of time and more frequently, leading to **prolonged** periods of extreme weather, such as heatwaves.

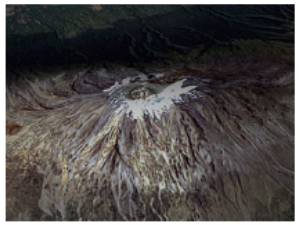
Evidence of Climate Change

Shrinking ice sheets

The Greenland and Antarctic ice sheets have decreased in mass. Data from NASA's Gravity Recovery and Climate Experiment show Greenland lost 150 to 250 cubic kilometers (36 to 60 cubic miles) of ice per year between 2002 and 2006, while Antarctica lost about 152 cubic kilometers (36 cubic miles) of ice between 2002 and 2005.

Image: Flowing meltwater from the Greenland ice sheet

Glacial retreat



Glaciers are retreating almost everywhere around the world — including in the Alps, Himalayas, Andes, Rockies, Alaska and Africa.[9]

Image: The disappearing snowcap of Mount Kilimanjaro, from space.

Decreased snow cover

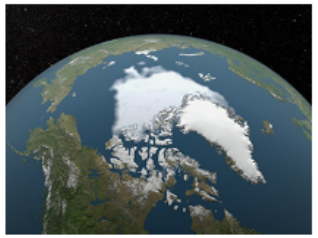
Satellite observations reveal that the amount of spring snow cover in the Northern Hemisphere has decreased over the past five decades and that the snow is melting earlier.[15]

Sea level rise

Global sea level rose about 8 inches in the last century. The rate in the last two decades, however, is nearly double that of the last century.[4]

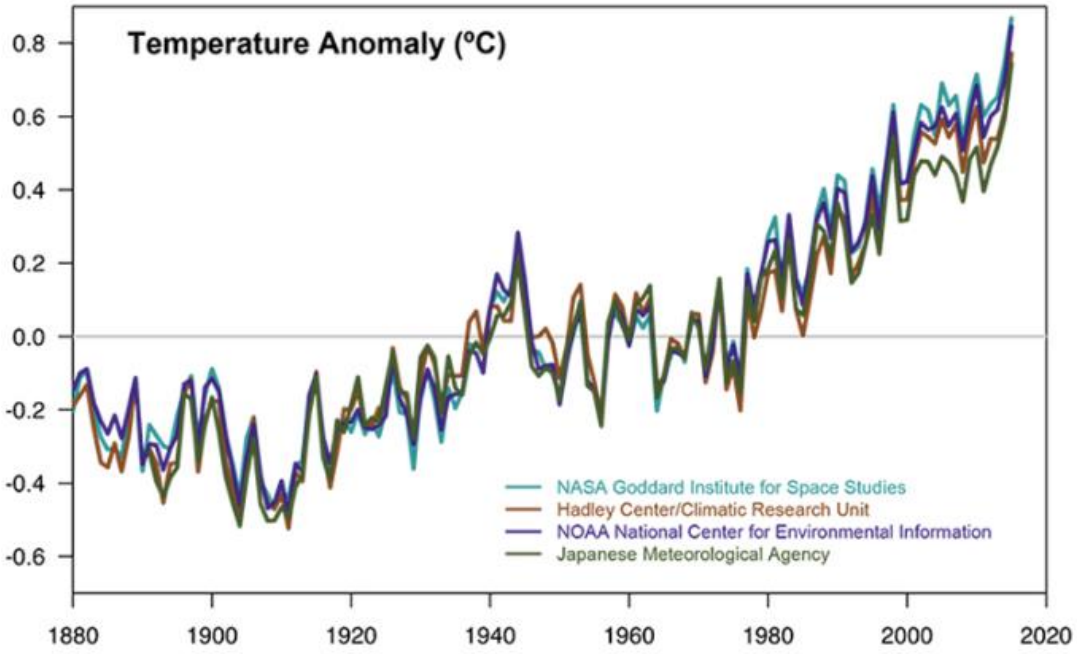
Image: Republic of Maldives: Vulnerable to sea level rise

Declining Arctic sea ice



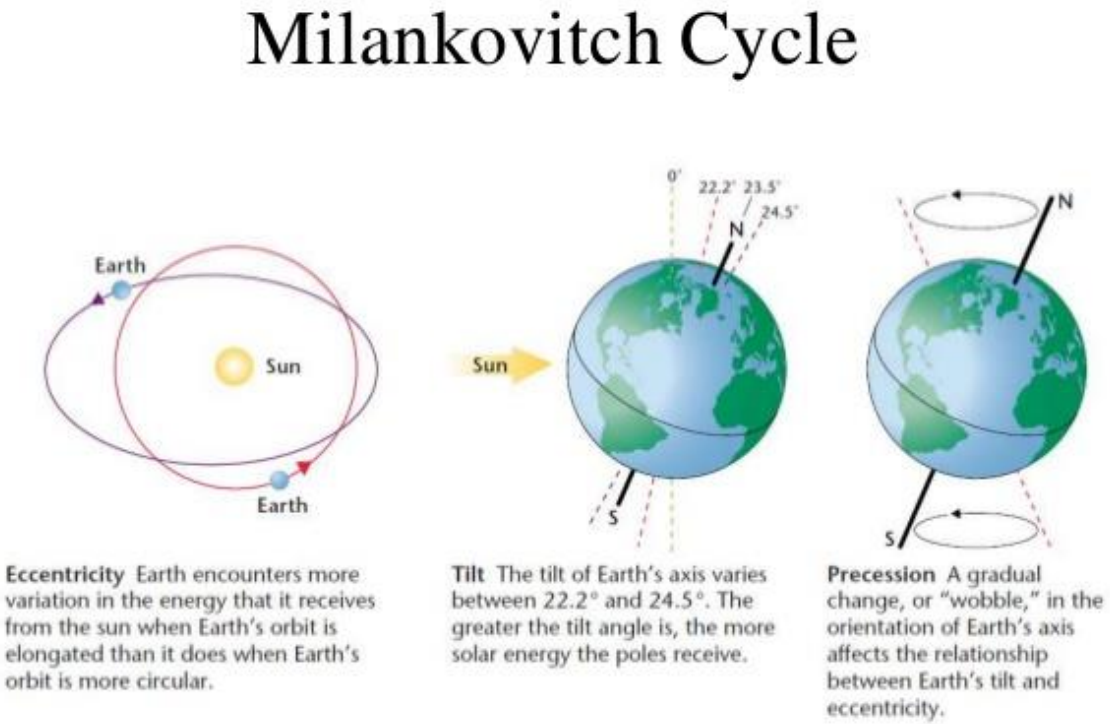
Both the extent and thickness of Arctic sea ice has declined rapidly over the last several decades.[8]

Image: Visualization of the 2012 Arctic sea ice minimum, the lowest on record



Temperature data from four international science institutions. All show rapid warming in the past few decades and that the last decade has been the warmest on record.

Natural Causes of Climate Change



Milankovitch was a geophysicist who studied the Earth's orbit and identified 3 distinct **cycles** that he believed affected the Earth's climate.

Scientists believe these cycles affect the timings and seasons of the Earth's climate. The 100,000 year **eccentricity cycle** coincides with the alternating glacial and inter-glacial periods.

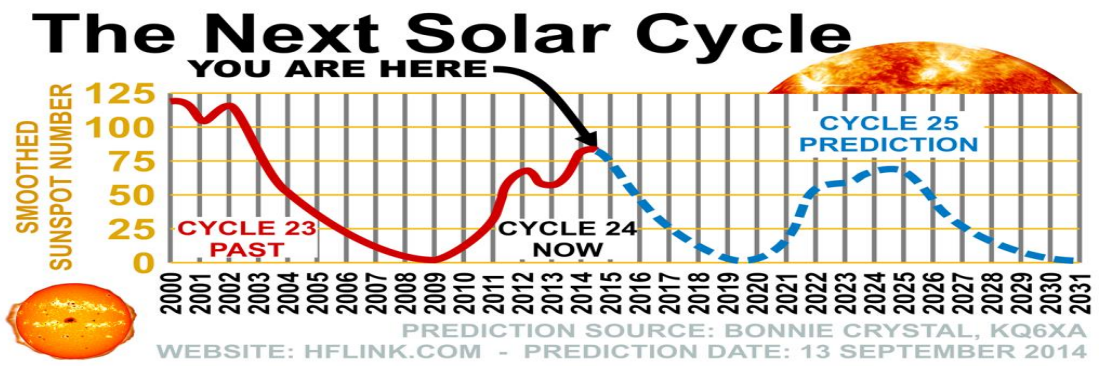
Solar Activity

Sunspot cycle – number of sunspots increases from a minimum to a maximum and then to a minimum again in around 11 years.

This causes **cyclical changes** in solar energy output.

1. When sunspot activity is at maximum, the Sun gives off more heat. Large explosions occur on the surface of the Sun leading to solar flares.

2. When sunspot activity is at a minimum, the solar output is reduced which can lead to lower temperatures on Earth.



Natural Causes of Climate Change

Volcanic Activity

Violent **volcanic eruptions** blast huge amounts of ash, gases and liquids into the atmosphere.

- Volcanic ash can **block out** the Sun
- This reduces temperatures on Earth
- This has a **short-term** impact

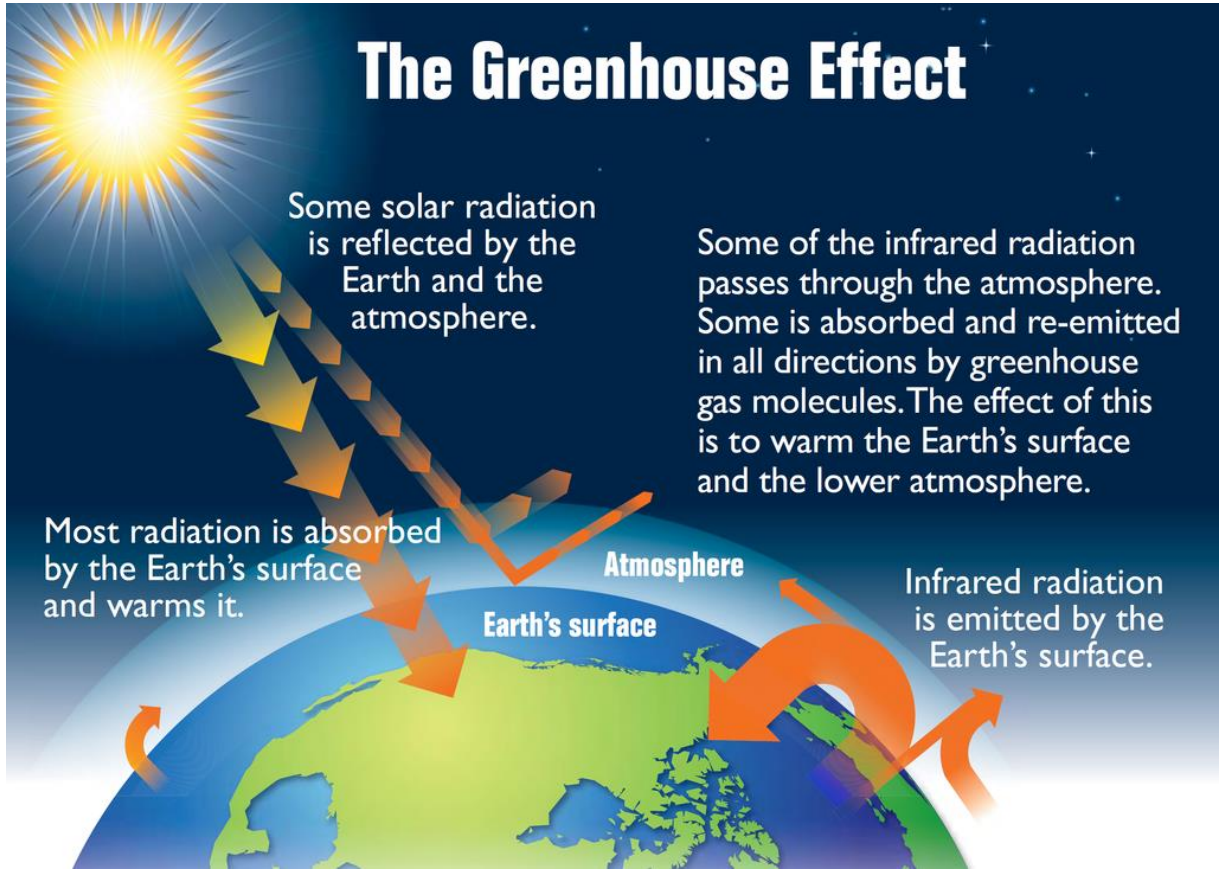
- Sulphur dioxide turns into drops of **sulphuric acid**
- These act like **tiny mirrors**, reflecting radiation from the Sun
- This can affect the climate for many years

Volcanic Winter - The cooling of the lower atmosphere and reduction of surface temperatures.

Case Study – Eruption of Mt Tambora, 1815

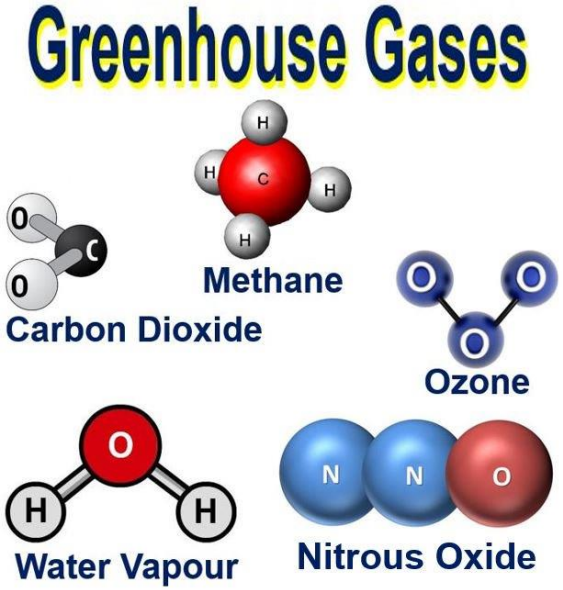
- Located in Indonesia
- Most powerful eruption for 1600 years
- Fallout caused average global temperatures to fall by 0.4-0.7°C
- Harvests failed worldwide
- Major food shortages in the USA and western Europe
- Resulted in 200,000 deaths

Human Causes of Climate Change



In recent years, the amounts of **greenhouse gases** have increased.

Scientists believe this is due to **human activity**.



Changes in **carbon dioxide concentration** in the atmosphere is in direct correlation with the trend in rising global temperatures. Many scientists believe that this shows that human activities are affecting global climates.

Recent global warming is being caused by **enhanced greenhouse effect** – the increased effectiveness of the greenhouse effect. This is caused by an increase in greenhouse gases.

By the end of the century, the average global temperature could **rise** by 1.8-4°C. This could lead to a sea level **rise** of 28-43cm.

Human Causes of Climate Change

Greenhouse Gas	Description	Caused by
CO_2 (carbon dioxide)	Accounts for 60% of the enhanced greenhouse effect. Global concentration has gone by 30% since 1850.	Burning fossil fuels (oil, gas, coal) Car exhausts Deforestation and burning wood
Nitrous Oxides	Very small concentrations in the atmosphere are up to 300 times more effective in capturing heat than carbon dioxide.	Agricultural fertilisers Car exhausts Power stations producing electricity Sewage treatment
Methane	Very effective in absorbing heat. Accounts for 20% of the enhanced greenhouse effect.	Burning biomass for energy Rice farming Decaying organic matter in landfill sites and compost heaps Farm livestock

Managing the Effects of Climate Change

To help reduce carbon dioxide emissions, many countries are turning to **alternative energy sources** of energy. For example:

- Hydro-electricity
- Nuclear power
- Solar, wind and tidal power

These do not emit large amounts of carbon dioxide and some are **renewable**.

The UK aims to produce **15%** of its electricity from alternative energy sources by **2020**.

Trees act as **carbon sinks** (remove carbon dioxide from atmosphere via **photosynthesis**).

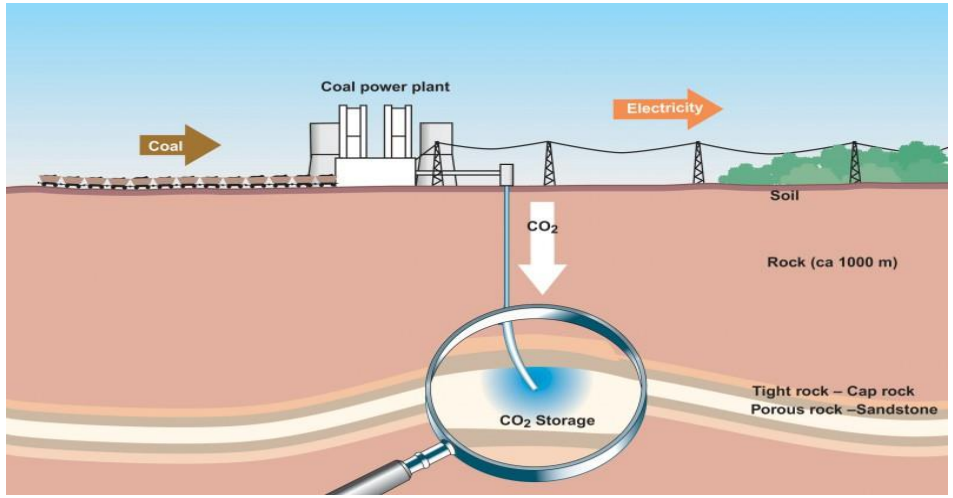
They also release **moisture** into the atmosphere, cooling the world by producing more clouds and reducing incoming **solar radiation**.

Plantation forests can absorb carbon dioxide at a **faster rate** than natural forests and can do so for 50 years.

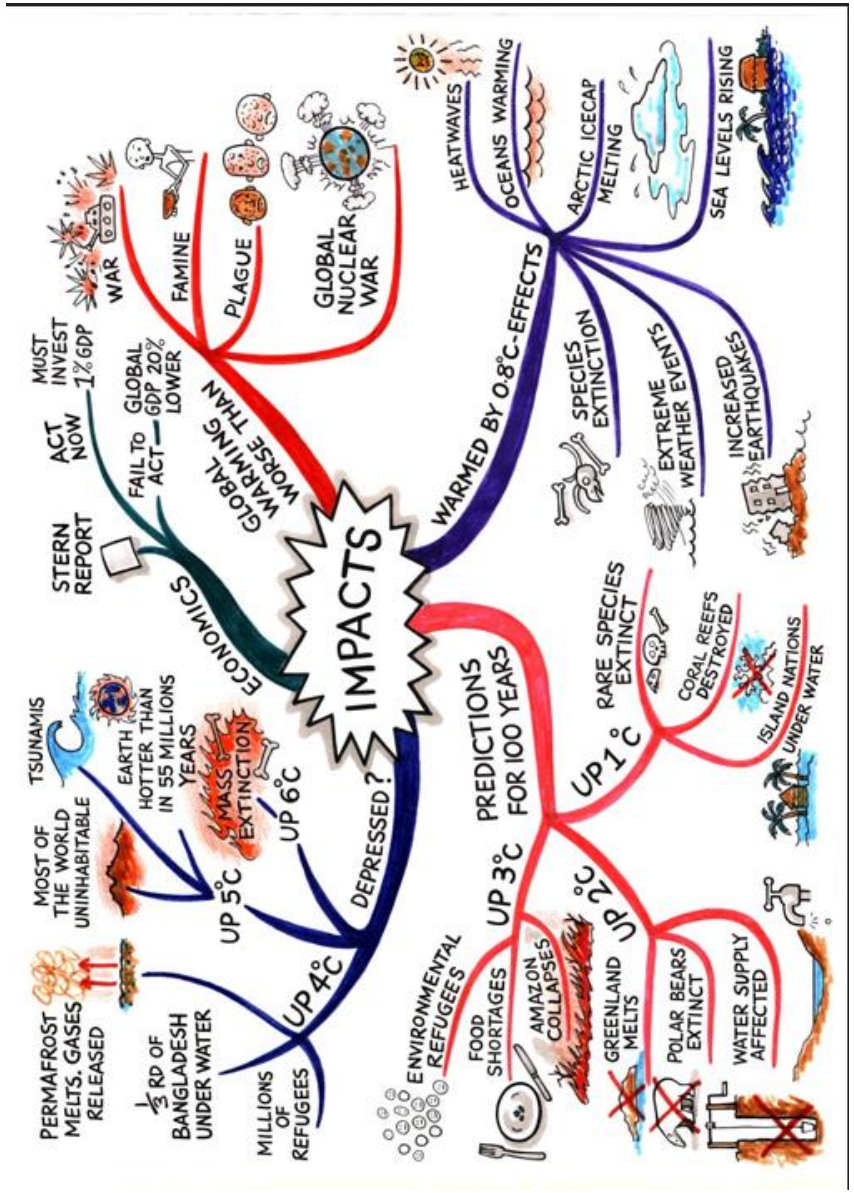
Carbon capture and storage (CCS) use technology to capture carbon dioxide produced from **fossil fue**ls burnt to generate electricity and industrial processes.

Could capture up to **90%** of the carbon dioxide that would end up in our atmosphere.

Once captured, the carbon dioxide gas is **compressed** and injected as a liquid into the ground.



Managing the Effects of Climate Change



International Agreements

2005 – Kyoto Protocol

- First **international treaty** and it became law
- Over 170 countries agreed to reduce carbon emissions by **5.2%** below their 1990 levels by 2012.

2009 – Copenhagen Accord

- Pledged to reduce carbon dioxide emissions
- **Financial support** for developing countries to help them cope with climate change impacts
- No legally binding agreement

2015 – Paris Agreement

- **195 countries** adopted first universal and legally binding **global** climate deal
- Aim to achieve balance between **sources and sinks** of greenhouse gases in second half of this century
- Keep global temperature increase **below 2°C**
- **$100 billion** a year to support climate change initiatives in developing countries by 2020

Adapting to Climate Change

Climate change will have huge impact on global **agricultural** systems.

1. Patterns of **rainfall and temperature** will change
2. Extreme weather events more common
3. Distribution of **pests and diseases** will change

Figure 4
Short furrow irrigation at the Steelpoort Canal Irrigation Scheme in Limpopo Province

Agricultural adaptation in low latitudes	Agricultural adaptation in middle latitudes
Greatest change to agricultural will be located here. Southern Africa's maize crop could fall by 30% by 2030. 1. Introduce drought-resistant strains of crops. 2. New irrigation systems 3. Water harvesting education for farmers 4. Shade trees to protect seedlings from Sun 5. New cropping patterns	1. Warmer climate in Europe and North American could lead to increase in production of certain crops, e.g. wheat. 1. In the UK, Mediterranean crops such as vines and olives may thrive.

Adapting to Climate Change

Managing Water Supply

1. Climate change is already causing more **severe and frequent** droughts and floods.
2. **Unreliable rainfall** requires careful management
3. The most vulnerable, rural parts of poorer countries will be affected the most.

West Rongbuk Glacier, Northern Slope of Mount Everest, 8848m, Tibet

PHOTOGRAPHY 1921: Major E.O. Wheeler. Courtesy of Royal Geographical Society. PHOTOGRAPHY 2008: David Breashears. Courtesy of GlacierWorks

Case Study – The Himalayas

- Millions of people reliant on **glacial melt** for water supply
- In Himalayas, most of the 16000 glaciers are **receding rapidly**
- Threatens long-term security of water here
- **Solution –** collect water in the winter through diversion channels which freezes.
- This melts in the spring and provides water

Reducing Risk from Rising Sea Levels

1. Average sea levels have risen by **20cm** since 1900
2. Expected to rise another **26-82cm** by 2100
3. This will flood important **agricultural land** in Bangladesh and India
4. Rates of **coastal erosion** will increase
5. Fresh water supplies will be **contaminated** with salt water

Case Study – The Maldives

- Construction of sea walls
- Houses built on stilts
- Artificial islands in case of relocation
- Restoration of coastal mangrove forests