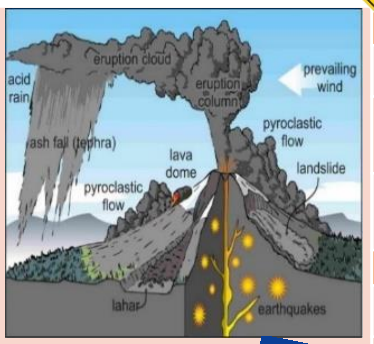
The structure of the Earth

The Crust	Varies in thickness (5-10km) beneath the ocean. Made up of several large plates.
The Mantle	Widest layer (2900km thick). The heat and pressure means the rock is in a liquid state that is in a state of convection.
The Inner and outer Core	Hottest section (5000 degrees). Mostly made of iron and nickel and is 4x denser than the crust. Inner section is solid whereas outer layer is liquid.

Volcanic Hazards

Ash cloud	Small pieces of pulverised rock and glass which are thrown into the atmosphere.
Gas	Sulphur dioxide, water vapour and carbon dioxide come out of the volcano.
Lahar	A volcanic mudflow which usually runs down a valley side on the volcano.
Pyroclastic flow	A fast moving current of super-heated gas and ash (1000°C). They travel at 450mph.
Volcanic bomb	A thick (viscous) lava fragment that is ejected from the volcano.



Managing Volcanic Eruptions

Warning signs	Monitoring techniques
Small earthquakes are caused as magma rises up.	Seismometers are used to detect earthquakes.
Temperatures around the volcano rise as activity increases.	Thermal imaging and satellite cameras can be used to detect heat around a volcano.
When a volcano is close to erupting it starts to release gases.	Gas samples may be taken and chemical sensors used to measure sulphur levels.

Preparation	
Creating an exclusion zone around the volcano.	Being ready and able to evacuate residents.
Having an emergency supply of basic provisions, such as food	Trained emergency services and a good communication system.

Convection Currents

The crust is divided into tectonic plates which are moving due to convection currents in the mantle.

1. Radioactive decay of some of the elements in the core and mantle generate a lot of heat.
2. When lower parts of the mantle molten rock (Magma) heat up they become **less dense** and **slowly rise**.
3. As they move towards the top they cool down, become **more dense** and **slowly sink**.
4. These **circular movements** of semi-molten rock are **convection currents**
5. Convection currents create **drag** on the base of the tectonic plates and this causes them to move.

LIC -CS: Haiti Earthquake 2010

Causes
On a conservative plate margin, involving the Caribbean & North American plates. The magnitude 7.0 earthquake was only 15 miles from the capital Port au Prince. With a very shallow focus of 13km deep.

Effects
230,000 people died and 3 million affected (P). Many **emotionally affected (S)**. **250,000 homes** collapsed or were damaged. **Millions homeless (P)**. Rubble blocked roads and shut down ports. (S)

Management/Responses
Individuals tried to recover people. Many countries **responded with appeals** or **rescue teams**. Heavily relied on **international aid**, e.g. **$330 million** from the EU. **98% of rubble** remained after **6 months**.

Earthquake Management

PREDICTING

Methods include:
- Satellite surveying (tracks changes in the earth's surface)
- Laser reflector (surveys movement across fault lines)
- Radon gas sensor (radon gas is released when plates move so this finds that)
- Seismometer
- Water table level (water levels fluctuate before an earthquake).
- Scientists also use seismic records to predict when the next event will occur.

PROTECTION

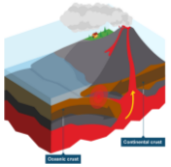
You can't stop earthquakes, so earthquake-prone regions follow these three methods to reduce potential damage:
- Building earthquake-resistant buildings
- Raising public awareness
- Improving earthquake prediction

Unit 1a
The Challenges of Natural Hazards

Types of Plate Margins

Destructive Plate Margin

When the denser plate subducts beneath the other, friction causes it to **melt and become molten magma**. The magma forces its ways up to the surface to form a volcano. This margin is also responsible for **devastating earthquakes**.



Constructive Plate Margin

Here two plates are **moving apart** causing new magma to reach the surface through the gap. Volcanoes formed along this crack cause a submarine mountain range such as those in the **Mid Atlantic Ridge**.

Conservative Plate Margin

A conservative plate boundary occurs where plates **slide past each other** in opposite directions, or in the same direction but at different speeds. This is responsible for earthquakes such as the ones happening along the San Andreas Fault, USA.

What is a Natural Hazard

A natural hazard is a natural process which could cause death, injury or disruption to humans, property and possessions.

Geological Hazard	Meteorological Hazard
These are hazards caused by land and tectonic processes.	**These are hazards caused by weather and climate.**

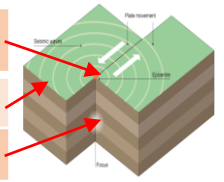
Causes of Earthquakes

Earthquakes are caused when two plates become **locked** causing **friction** to build up. From this **stress**, the **pressure** will eventually be released, triggering the plates to move into a new position. This movement causes energy in the form of **seismic waves**, to travel from the **focus** towards the **epicentre**. As a result, the crust vibrates triggering an earthquake.

The point directly above the focus, where the seismic waves reach first, is called the **EPICENTRE**.

SEISMIC WAVES (energy waves) travel out from the focus.

The point at which pressure is released is called the **FOCUS**.



HIC - CS: New Zealand – Earthquake 2011

Causes - Earthquake struck New Zealand's South Island on 22nd February 2011 at 12:51pm and was a magnitude 6.3 on the Richter scale. It occurred on a conservative plate margin where the Pacific Plate slid past the Australian Plate in the opposite direction.

Effects
181 people were killed.
Gas pipes burst and caught fire.
Land was damaged by liquefaction (land turns to mud and house sink).
Landslides caused serious damage to buildings.
2000 people treated for injuries.

Management/Responses
Australian Govt. donated NZ$6.7 million to the Red Cross Appeal.
Bottled water was provided as water supplies were cut off.
Closed the airport as a precaution
Review of all building codes to make buildings stronger
27,000 chemical toilets were flown into the area as sanitation and sewerage works were damaged

Factors affecting risk	
Urbanisation	Densely populated areas are at more risk of natural hazards. Some of the largest cities are on plate margins.
Poverty	If you live in poverty you are more likely to die from natural hazards. Shortage of housing, it is poor quality (fall down easily), build on unstable slopes prone to floods and landslides.
Climate change	A warmer world will have more energy leading to more intense storms and hurricanes. Some parts of the world will get wetter with more risk of flooding. Others will get hooter & drier leading to droughts and famine.
Farming	When a river floods it deposits fertile silt on its floodplain, which is good for farming. People chose to live there and put themselves at risk of flooding,.

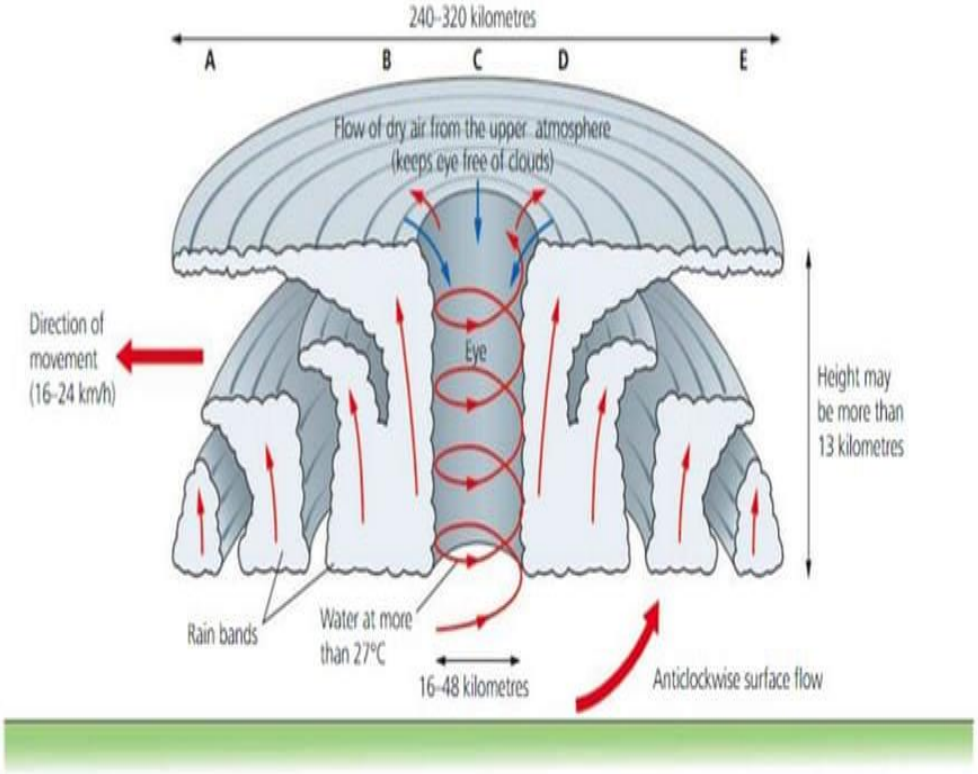
Primary & secondary effects	
Primary effects	These happen straight away as a direct result of the hazard – buildings falling down, people dying
Secondary effects	These happened later on as an indirect effect of the hazard – water polluted due to dead bodies, fires due to burst gas pipes, collapse of the economy due to damaged buildings.
Short-term/immediate responses	Actions that happened straight after the hazard designed to help people – rescue people, give people water, first aid food, temporary shelter such as tents
Long-term responses	Actions over a longer time period – new building codes to make them stronger, repair bridges, training programmes to help people respond to the hazard better in the future.

Formation of volcanoes at plate margins	
Destructive plate margins	The oceanic plate is more dense and subducts under the continental plate. Convection currents pull the plate along. As the oceanic plate sinks it melts and form magma. Magma rises up through the crust working its way through cracks and then erupts on the surface. It builds up layers of lava and ash to form a large steep-sided volcano.
Constructive plate margins	The plates are pulled apart by convection currents. Magma rises and hits the sea. It cools to form rock. Over time layers of lava build up to form a volcano with gently sloping sides.

Why live in hazardous areas?	
Don't happen very often so people do not see them as a threat	Too poor to move anywhere else/jobs and family are in this area
Strong building design so people do not feel the need to move (HICs)	Volcanoes can bring benefits – fertile soils for farming, mining, hot water
More effective monitoring of the hazards so people feel safer as they can evacuate quickly	Some people may not be aware of the hazards – a lack of education

Structure of tropical storms

A At the start of a tropical storm, the temperature and air pressure fall. Air rises and clouds begin to form. It becomes windy.
B As the tropical storm continues, the air pressure falls more rapidly, wind increases, cumulonimbus cloud forms and there is heavy rainfall.
C There is a period of calm with no wind or rain at the eye of the storm. The Sun appears, so it gets warmer. Air pressure is very low.
D Wind and heavy rainfall increase dramatically again, the temperature drops and air pressure begins to rise.
E As the tropical storm ends, the air pressure and temperature rise. Wind and rainfall subside.



UK Weather Hazards

Rain

Too much rain over a short or prolonged period can cause **flooding,** which can damage homes, transport and cause deaths. It can also force business to close. This can cost millions of pounds.

Hailstorms

Can make driving dangerous and can damaged crops and property.

Wind

Strong winds (gales) cam damage properties and close transportation. It can also uproot trees, which can injure or kill people. Winds are strongest at coastal area esp. west coast and upland areas.

Snow and Ice

Snow and ice can cause injuries due to slipping and deaths from the cold. Schools and business are sometimes shut and it can disrupt all transport (air, road and rail, which has economic impacts. It can also damage crops.

Drought and Heatwaves

Drought is a lack of precipitation, this can cause water supplies to become too low. This can damage crops, which damaged the economy. Rules to conserve water are usually introduced during droughts

Heatwaves sometimes occur in the UK, when we have long periods of hot weather, It can cause deaths from heat exhaustion or breathing difficulties as pollution builds up in the air. It can cause problems with transport also.

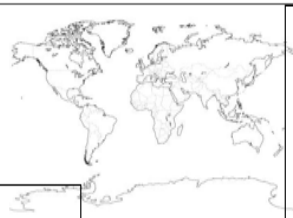
Thunderstorms

Heavy rain, lightening and strong winds occur during thunderstorms. They are common in summer in the UK usually in the south or east (hotter here). Lightening can cause death and fire s than damage the environment and property.

Effects of Global Warming / Global climate change - The increase in global temperatures will effect the world and no one can escape the impacts.

Environmental

- Increase temperatures cause Ice Caps melt – sea levels rise + Polar Bear lose habitat
- Rising temperatures decrease rainfall
- Ecosystems and species are being threatened i.e. coral reefs



Social:

- Increase in temperatures –droughts -> lack of food -> famine
- Sea Levels Rise -> Island countries i.e Maldives under water, Bangladesh -> displaced – migration to other countries
- Increase in temperatures (oceans) -> more hurricanes
- Increase in temperatures means tropical diseases such as malaria spreads to less tropical countries i.e. Spain
- Increase in temperatures -> INCREASE DEMAND FOR WATER -> more conflict about water i.e. Sub Saharan Africa

Political

- Conflict between countries as water becomes more scarce
- Mass migration of countries like Bangladesh and the Maldives will mean some countries will have to cope with an increased amount of immigration and emigration
- Governments will be under pressure to cope with the impacts of climate change

Economic

- Governments will have to spend more preparing for more extreme weather (tropical storms)
- Insurance companies will have to pay out more
- Sustainable industries may make more money (+)

UK Impacts

Economic

- Farmers will be able to grow some new crops such as olives and oranges which could increase our economy (+)
- The government will have to spend a lot more money on protecting us from extreme weather e.g more flood defences (-)
- Sea Level Rise – Coastal Erosion – East of the UK – House insurance increase and difficult to sell houses (-)
- More tourism staying in countries like the UK (+)

Social:

- Increase in temperatures means tropical diseases such as malaria spreads to the UK (-)
- Less injuries/car accidents due to cold weather (+)
- More heat related deaths – skin cancer, dehydration (-)

Environmental

- Some plants in Scotland will become extinct (-)
- Seal levels will rise causing more coastal erosion and flooding (-)

Political - Government is under pressure to cope and reduce the impacts of climate change (-)

Managing Climate Change

Temperatures are expected to rise by 0.3-4.8C between 2005 and 2100. In order to cope with some of these effects, people are trying to reduce the causes of climate change, by reducing the concentration of greenhouse gases in the atmosphere.

Mitigation Strategies to reduce the causes of Climate Change

Alternative Energy Production

1. Replacing fossil fuels with nuclear power and renewable energy can help reduce climate change by reducing greenhouse gas emissions from power station burning fossil fuels.
2. In the UK, more offshore wind farms are being built, several wave and tidal power projects are planned and a new nuclear power plant.
3. The UK is also encouraging people through grants to install solar power in their homes.

Planting Trees

Planting trees increases the amount of carbon dioxide than is absorbed from the atmosphere through photosynthesis

Carbon Capture

1. **Carbon Capture and Storage (ccs)** is a new technology designed to reduce climate change by reducing emissions from fossil fuel burning power stations.
2. CCS involved capturing CO2 and transporting it to places where it can be stored safely usually deep underground.

International Agreements

From 1997, most HIC countries agreed to monitor and cut greenhouse gases (not the US) in an agreement called the **Kyoto Protocol.** The aim was to cut greenhouse gas emissions by 5% by 2012. Each country was set a target (UK 12.5% - met it 22%)

In 2015 an agreement the **Paris Climate Change agreement** was signed by 196 countries. They agreed to keep global temperatures well below 2.0C, limit the amount of greenhouse gases emitted by human activity to the same levels that it can be absorbs naturally (trees), Review each countries progress in 5 years and scale up the challenge, HICs to donate $800 billion to LICs to help them adapt to climate change and switch to renewable energy.

Adaptation Means responding to changes caused by climate change

Reducing risk from rising Sea Levels

Sea Levels are predicted to rise by up to 82cm by 2100, which would flood many island and coastal areas..

1. **Physical defences** such as flood barriers are being built and better flood warning systems are being put in place. E.g. Thames Barrier in London can be closed to prevent sea water flooding the city.
2. In areas that cant afford expensive flood defences, e.eg Bangladesh, people are building their houses on top of **earth embankments** and building raised food shelters to use in emergencies. And **houses built on stilts.**

Managing Water Supply

Dry areas are predicted to get drier, leading to **water shortages,** so water supplies will need to be used more efficiently. Climate Change is cause an increase in frequency in droughts, which means unreliable rainfall and periods of water shortage. Poorer countries are more likely to be affected the most.

1. **Water meters** can be installed in peoples homes to discourage them from using a lot of water
2. **Rainwater can be collected** and waste water can be recycles to make more water available.

Changing Agricultural Systems

Because Global Warming is likely to change rainfall patterns and cause higher temperature. This will affect the productivity of crops.

1. Middle Latitude Countries: May need to plant **new crop types** that are suitable to this climate e.g. **soya, peaches, and grapes** may be grown in the south of the UK
2. Lower Latitude Countries: Use of biotechnology to create new crops varieties which are **more resistant** to extreme weather events e.g. drought resistant millet being grown in Kenya.

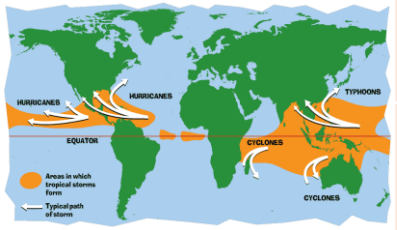
Global pattern of air circulation

Atmospheric circulation is the large-scale movement of air by which heat is distributed on the surface of the Earth.

Hadley cell	Largest cell which extends from the **Equator** to between **30° to 40° north & south**.
Ferrel cell	Middle cell where air flows **poleward** between **60° & 70°** latitude.
Polar cell	**Smallest & weakness** cell that occurs from the poles to the Ferrel cell.

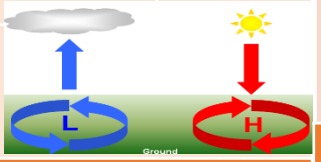
Distribution of Tropical Storms.

They are known by many names, including hurricanes (North America), cyclones (India) and typhoons (Japan and East Asia). They all occur in a band that lies roughly 5-15° either side of the Equator.



High and Low Pressure

Low Pressure	High Pressure
Caused by hot air rising. Causes stormy, cloudy weather.	**Caused by cold air sinking. Causes clear and calm weather.**



Formation of Tropical Storms

1	The sun's rays heats large areas of ocean in the summer and autumn. This causes **warm, moist air** to rise over the particular spots
2	Once the **temperature is 27°**, the rising warm moist air leads to a **low pressure**. This eventually turns into a thunderstorm. This causes air to be sucked in from the **trade winds**.
3	With trade winds blowing in the opposite direction and the rotation of earth involved (Coriolis effect), the thunderstorm will eventually start to **spin**.
4	When the storm begins to **spin faster than 74mph**, a tropical storm (such as a hurricane) is officially born.
5	With the tropical storm growing in power, **more cool air sinks** in the centre of the storm, creating calm, clear condition called the **eye of the storm**.
6	When the tropical storm hits land, it **loses its energy source** (the warm ocean) and it begins to lose strength. Eventually it will 'blow itself out'.

Changing pattern of Tropical Storms

Scientist believe that global warming is having an impact on the frequency and strength of tropical storms. This may be due to an increase in ocean temperatures.

Management of Tropical Storms

Protection
Preparing for a tropical storm may involve construction projects that will improve protection.

Aid
Aid involves assisting after the storm, commonly in LIDs.

Development
The scale of the impacts depends on the whether the country has the resources cope with the storm.

Planning
Involves getting people and the emergency services ready to deal with the impacts.

Prediction
Constant monitoring can help to give advanced warning of a tropical storm

Education
Teaching people about what to do in a tropical storm.

Primary Effects of Tropical Storms

- The intense winds of tropical storms can destroy whole **communities, buildings** and **communication networks**.
- As well as their own destructive energy, the winds can generate abnormally high waves called **storm surges**.
- Sometimes the most destructive elements of a storm are these subsequent **high seas and flooding** they cause to coastal areas.

Secondary Effects of Tropical Storms

- People are **left homeless**, which can cause distress, poverty and ill health due to lack of shelter.
- **Shortage of clean water** and **lack of proper sanitation** makes it easier for diseases to spread.
- **Businesses are damaged** or destroyed causing employment.
- Shortage of food as **crops are damaged**.

Case Study: Typhoon Haiyan 2013

Causes
Started as a tropical depression on **2rd November 2013** and gained strength. Became a Category 5 **"super typhoon"** and made landfall on the Pacific islands of the Philippines.

Effects
- Almost **6,500 deaths**.
- **130,000 homes destroyed.**
- Water and sewage systems destroyed had caused **diseases**.
- **Emotional grief** for dead.

Management
- The UN raised **£190m in aid**.
- USA & UK **sent helicopter carrier ships** deliver aid remote areas.
- **Education** on typhoon preparedness.

Case Study: UK Heat Wave 2003

Causes
The heat wave was caused by an anticyclone (areas of high pressure) that stayed in the area for most of August. This blocked any low pressure systems that normally brings cooler and rainier conditions.

Effect
- People suffered from heat strokes and dehydration.
- 2000 people died from causes linked to heatwave.
- Rail network disrupted and crop yields were low.

Management
- The NHS and media gave guidance to the public.
- Limitations placed on water use (hose pipe ban).
- Speed limits imposed on trains and government created 'heatwave plan'.

What is Climate Change?

Climate change is a large-scale, long-term shift in the planet's weather patterns or average temperatures. Earth has had tropical climates and ice ages many times in its 4.5 billion years.

Recent Evidence for climate change.

Global temperature	Average global temperatures have increased by more than **0.6°C since 1950**.
Ice sheets & glaciers	Many of the world's glaciers and ice sheets are melting. E.g. the Arctic sea ice has declined by **10% in 30 years**.
Sea Level Change	Average global **sea level has risen by 10-20cms** in the past 100 years. This is due to the additional water from ice and thermal expansion.

Human cause - Enhanced Greenhouse Effect

Recently there has been an increase in **humans burning fossil fuels** for energy. These fuels (gas, coal and oil) emit **greenhouse gases**. This is making the Earth's atmosphere thicker, therefore trapping more solar radiation and causing **less to be reflected**. As a result, the Earth is becoming warmer.

Evidence of natural change

Orbital Changes	Some argue that climate change is linked to how the Earth orbits the Sun, and the way it wobbles and tilts as it does it.
Sun Spots	Dark spots on the Sun are called Sun spots. They increase the **amount of energy Earth receives** from the Sun.
Volcanic Eruptions	Volcanoes release large amounts of **dust containing gases**. These can **block sunlight** and results in cooler temperatures.

Managing Climate Change

Carbon Capture
This involves new technology designed to reduce climate change.

Planting Trees
Planting trees increase the amount of carbon is absorbed from atmosphere.

International Agreements
Countries aim to cut emissions by signing international deals and by setting targets.

Renewable Energy
Replacing fossil fuels based energy with clean/natural sources of energy.