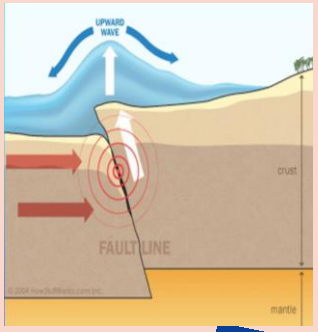
Unit 1a
The Challenges of Natural Hazards

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.

Earthquake Hazard

Ground shaking	Land can become unstable and liquefaction can lead to extensive building damage.
Death and injury	Buildings collapse crushing people and leaving many homeless.
Damage to roads & buildings	Supplies and communications are disrupted. Remote communities cut off.
Tsunami	Earthquakes that occur out at sea can lead to a tsunami risk.
Fires and landslides	Gas pipes can rupture and electricity cables break leading to a fire risk.



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.

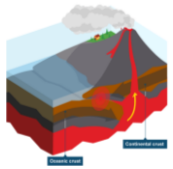
Effects
230,000 people died and 3 million affected. Many **emotionally affected**. **250,000 homes** collapsed or were damaged. **Millions homeless**. Rubble blocked roads and shut down ports.

Management
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**.

Types of Plate Margins

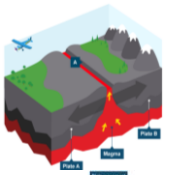
Destructive Plate Margin

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.**

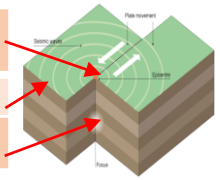
Causes of Earthquakes

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**.



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

Earthquake Proof Buildings

Design	Construction
Cross bracing to provide extra support to the frame	Reinforced concrete is used to prevent it crumbling and falling in an earthquake
Large weights are placed on the top of the building to counter the sway	Hollow concrete bricks cause minimum damage

Geology

Deep foundations to anchor the building in place	Built on solid rock through which seismic waves travel slowly and reduce movement
Essential services are built away from fault lines	Avoid reclaimed land that could suffer from liquefaction

HIC - CS: Sendai Earthquake Japan 2011

Causes
Japan is located on the plate boundary between the The Eurasian, Pacific and Philippines plate. The plate boundary is DESTRUCTIVE. The earthquake was a 8.9 on the Richter Scale and the depth was 70km.

Effects
15,854 people died (most from the tsunami) 24,000 injured. 130,000 buildings collapsed, 4.4 million without electricity, 1.5 million without water. Economic loss US$235 bill. Ports temporarily closed. 10% of fishing ports closed. Fukishima nuclear plant meltdown contamination of sea and land.

Management
High capacity to cope. 40% of Japan's coastline has a sea wall. Japanese Meterological Agency predicts.Issued warnings on TV so people left buildings. Buildings earthquake proof so could sway and move. Tsunami warnings

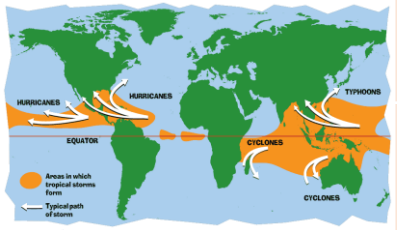
Global pattern of air circulation

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.

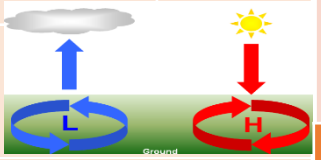
Distribution of Tropical Storms.

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 **4,000 deaths**.
- **130,000 homes destroyed.**
- Water and sewerage 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 Boscastle UK 2004

Causes- Over 60mm of rain fell in 2 hours. Ground already saturated due to weeks of above average rain. Steep slopes on drainage basin-rapid runoff. Confluence of rivers Valency, Jordan and Paradise meant a lot of water arrived quickly.

Effects- Homes, businesses and cars belonging to 1000 people swept away.
Income from tourism lost
Insurance claims
Rapid response of emergency services meant no one died

Management -£4.5 million has been spent on a flood defence scheme. Boscastle car park has been raised in height, which will stop the river from bursting its banks so easily. New drains allow water to run into the lower section of the river quickly.

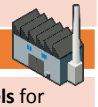
What is Climate Change?

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.

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.