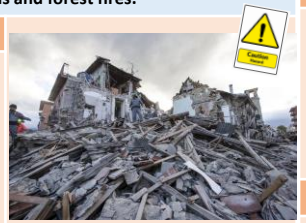
Unit 1a
The Challenge of Natural Hazards

What are Natural Hazards?

Natural hazards are physical events such as earthquakes and volcanoes that have the potential to do damage to humans and property. Hazards include tectonic hazards, tropical storms and forest fires.

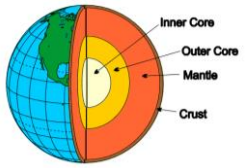
What affects hazard risk?

Population growth
Global climate change
Deforestation
Wealth - LICs are particularly at risk as they do not have the money to protect themselves



Structure of the Earth

The earth has 4 layers
The core (divided into inner and outer), mantle and crust.



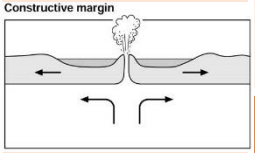
The crust is split into major sections called **tectonic plates**.

There are 2 types of crust: **Oceanic** (thin and younger but dense) and **Continental** (old and thicker but less dense).

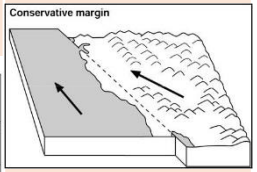
These plates move due to convection currents in the mantle and, where they meet, tectonic activity (volcanoes and earthquakes) occurs..

Plates either move towards each other (**destructive** margin) away from each other (**constructive**) or past each other (**conservative**).

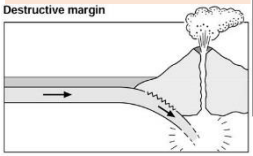
Constructive margin



Conservative margin



Destructive margin



Earthquakes and Volcanoes

Volcanoes	Earthquakes
- **Constructive** margins – Hot magma rises between the plates e.g. Iceland. Forms Shield volcanoes. - **Destructive** margins – an oceanic plate subducts under a continental plate. Friction causes oceanic plate to melt and pressure forces magma up to form composite volcanoes e.g. the west coast of South America.	- **Constructive** margins – usually small earthquakes as plates pull apart. - **Destructive** margins – violent earthquakes as pressure builds and is then released. - **Conservative** margins – plates slide past each other. They catch and then as pressure builds it is released e.g. San Andreas fault.

Effects of Tectonic Hazards

Primary effects happen immediately. Secondary effects happen as a result of the primary effects and are therefore often later.

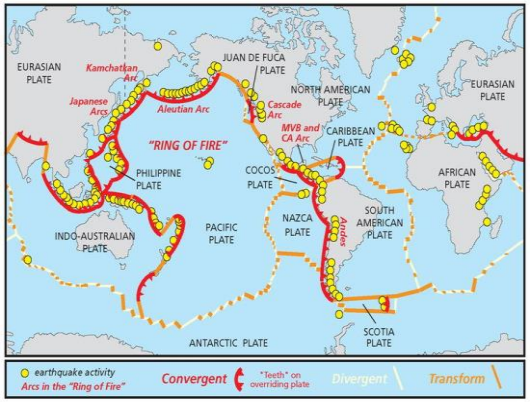
Primary - Earthquakes	Secondary - Earthquakes
- Property and buildings destroyed. - People injured or killed. - Ports, roads, railways damaged. - Pipes (water and gas) and electricity cables broken.	- Business reduced as money spent repairing property. - Blocked transport hinders emergency services. - Broken gas pipes cause fire. - Broken water pipes lead to a lack of fresh water.
Primary - Volcanoes	**Secondary - Volcanoes**
- Property and farm land destroyed. - People and animals killed or injured. - Air travel halted due to volcanic ash. - Water supplies contaminated.	- Economy slows down. Emergency services struggle to arrive. - Possible flooding if ice melts Tourism can increase as people come to watch. - Ash breaks down leading to fertile farm land.

Responses to Tectonic Hazards

Immediate (short term)	Long-term
- Issue warnings if possible. **- Rescue teams search for survivors.** **- Treat injured.** **- Provide food and shelter, food and drink.** **- Recover bodies.** **- Extinguish fires.**	**- Repair and re-build properties and infrastructure.** **- Improve building regulations** **- Restore utilities.** **- Resettle locals elsewhere.** **- Develop opportunities for recovery of economy.** **- Install monitoring technology.**

Distribution of tectonic activity

Along plate boundaries.
On the edge of continents.
Around the edge of the Pacific.



Comparing Earthquakes – Haiti and Japan

	Haiti Jan 12th 2010. Magnitude 7	Japan March 2011. Magnitude 9
Primary Effects	316,000 people died Buildings were not built to be earthquake proof so they collapsed easily	The number of confirmed deaths is 15,894. More than 2,500 people are still reported missing About 250 miles (400 km) of Japan's northern Honshu coastline dropped by 2 feet
Secondary Effects	More than a million people were made homeless Estimated that 250,000 residences and 30,000 commercial buildings had collapsed or were severely damaged. Rubble from collapsed buildings blocked roads and rail links – limiting rescue attempts.	The tsunami flooded an estimated area of approximately 217 square miles (561 square kilometers) in Japan. The tsunami caused a cooling system failure at the Fukushima Daiichi Nuclear Power Plant, which resulted in a level-7 nuclear meltdown and release of radioactive materials More than 120,000 buildings were destroyed, 278,000 were half-destroyed and 726,000 were partially destroyed. The total economic cost could reach up to $235 billion
Immediate Responses	Communication systems, transport and hospitals had been damaged by the earthquake, which slowed rescue and aid efforts. Delays in aid distribution led to looting and violence.	Residents of Tokyo received a minute of warning before the strong shaking hit the city, thanks to Japan's earthquake early warning system. The country's stringent seismic building codes and early warning system prevented many deaths from the earthquake, by stopping high-speed trains and factory assembly lines. People in Japan also received texted alerts of the earthquake and tsunami warnings on their cellphones
Long term responses	6 months after the quake, 98% of the rubble remained un cleared, some still blocking vital access roads. 1.6 million people still in camps with no electricity, running water, or sewage disposal	The country recently unveiled a newly installed, upgraded tsunami warning system. Teams studied the tsunami deposits to better understand ancient sediment records of the deadly waves. Earthquake engineers examined the damage, looking for ways to build buildings more resistant to quakes and tsunamis.

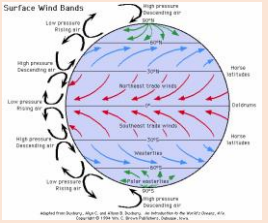
LICs suffer more than HICs from natural disasters because they are not as prepared and struggle to react effectively.

Reducing the impact of tectonic hazards

Monitoring	Prediction
Seismometers measure earth movement. Volcanoes give off gases.	**By observing monitoring data, this can allow evacuation before event.**
Protection	**Planning**
Reinforced buildings and making building foundations that absorb movement. Automatic shut offs for gas and electricity.	**Avoid building in at risk areas. Training for emergency services and planned evacuation routes and drills.**

Global atmospheric circulation

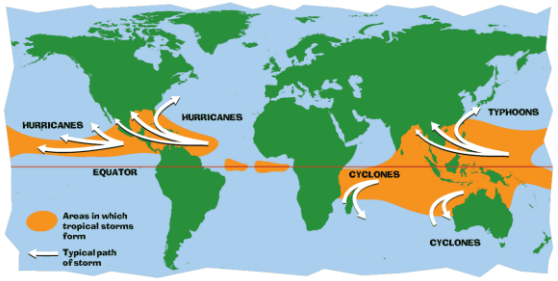
At the equator, the sun's rays are most concentrated. This means it is hotter. This one fact causes global atmospheric circulation at different latitudes.



High pressure = dry
Low pressure = wet
As the air heats it rises – causing low pressure. As it cools, it sinks, causing high pressure. Winds move from high pressure to low pressure. They curve because of the **Coriolis** effect (the turning of the Earth)

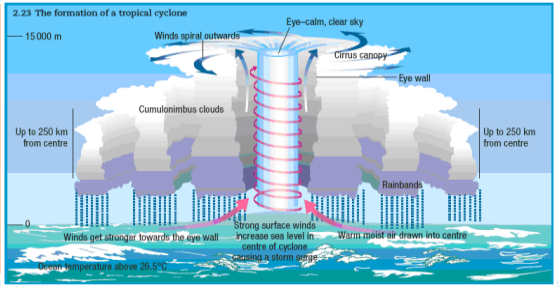
Tropical Storms

Occur in low latitudes between 5° and 30° north and south of the equator (in the tropics). Ocean temperature needs to be above 27° C. Happen between summer and autumn.



Sequence of a Tropical Storm

1. **Air is heated above warm tropical oceans.**
2. **Air rises under low pressure conditions.**
3. **Strong winds form as rising air draws in more air and moisture causing torrential rain.**
4. **Air spins due to Coriolis effect around a calm eye of the storm.**
5. **Cold air sinks in the eye so it is clear and dry.**
6. **Heat is given off as it cools powering the storm.**
7. **On meeting land, it loses source of heat and moisture so loses power.**



Climate change will affect tropical storms too. Warmer oceans will lead to more intense storms – but not necessarily more frequent ones.

Extreme weather in the UK

Rain – can cause flooding damaging homes and business.
Snow & Ice – causes injuries and disruption to schools and business. Destroys farm crops.
Hail – causes damage to property and crops.
Drought – limited water supply can damage crops.
Wind – damage to property and damage to trees potentially leading to injury.
Thunderstorms – lightening can cause fires or even death.
Heat waves – causes breathing difficulties and can disrupt travel.

UK weather is getting more extreme due to climate change. Temperatures are more extreme and rain is more frequent and intense leading to more flooding events. Since 1980 average temperature has increased 1 degree and winter rainfall has increased.

Typhoon Haiyan, Philippines, November 2013

Primary Effects	Secondary Effects
At least 6340 killed 314 km/hr wind speeds. 5m Storm Surge 90% buildings in Tacloban destroyed Habitats & Crops destroyed	$14 Billion of damage Water supply polluted 130,000 houses destroyed, leaving 4.2 million homeless Public Order – Looting Airports unusable for supplies

Immediate Responses	Long-term Responses
1,069 emergency shelters set up in public buildings. Disaster Emergency Committee helped 3,316,500 people outside these centres by providing aid. UK aid charities provided shelter, food and medical supplies.	UN appeal raised $300 million. Typhoon warning systems have been improved. People are now better educated about how to respond.

Prediction	Planning	Protection
Monitoring wind patterns allows path to be predicted. Use of satellites to monitor path to allow evacuation	Avoid building in high risk areas Emergency drills Evacuation routes	Reinforced buildings and stilts to make safe Flood defences e.g. levees and sea walls Replanting Mangroves

27th-28th October 2013 – St. Judes Storm

Crossed 2000km in less than 26hrs across the Atlantic Ocean.

Social Effects

4 deaths.
850,000 homes affected by power cuts.
Appointments in many hospitals in Cumbria were cancelled as hospitals had no mains electricity.

Economic Effects

130 flights were cancelled
£130 million of insurance payouts

Environmental impacts

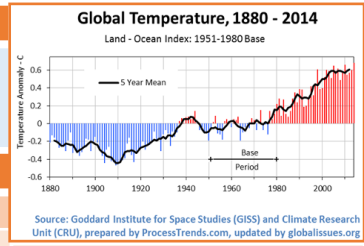
Large amounts of soil were washed into the rivers, with millions of tonnes of silt transported by rivers and deposited on floodplains 99mph winds. 10 million trees destroyed

Management strategies

Met Office issued weather warning
Environment agency issued warnings to scale back utility and transport thus limiting damage.
Swift response from electricity having only 3110 houses left with no power by 3rd nov.

Climate Change – natural or human?

Evidence for climate change shows changes before humans were on the planet. So some of it must be natural. However, the **rate** of change since the 1970s is unprecedented. Humans are responsible – despite what Mr Trump says!



Causes

Natural	Human
- **Orbital changes** – The sun's energy on the Earth's surface changes as the Earth's orbit is elliptical its axis is tilted on an angle. - **Solar Output** – sunspots increase to a maximum every 11 years. - **Volcanic activity** – volcanic aerosols reflect sunlight away reducing global temperatures temporarily.	- **Fossil fuels –** release carbon dioxide with accounts for 50% of greenhouse gases. - **Agriculture –** accounts for around 20% of greenhouse gases due to methane production from cows etc. Larger populations and growing demand for met and rice increase contribution. - **Deforestation –** logging and clearing land for agriculture increases carbon dioxide in the atmosphere and reduces ability to planet to absorb carbon through photosynthesis.

Effects of Climate Change

Social	Environmental
- Increased disease eg. skin cancer and heat stroke. - Winter deaths decrease with milder winters. - Crop yields affected by up to 12% in South America but will increase in Northern Europe but will need more irrigation. - Less ice in Arctic Ocean increases shipping and extraction of oil and gas reserves. - Droughts reduce food and water supply in sub-Saharan Africa. Water scarcity in South and South East UK. - Increased flood risk. 70% of Asia is at risk of increased flooding - Declining fish in some areas affect diet and jobs. - Increased extreme weath - Skiing industry in Alps threatened.	- Increased drought in Mediterranean region. - Lower rainfall causes food shortages for orangutans in Borneo and Indonesia. - Sea level rise leads to flooding and coastal erosion. - Ice melts threaten habitats of polar bears. - Warmer rivers affect marine wildlife. - Forests in North America may experience more pests, disease and forest fires. - Coral bleaching and decline in biodiversity.

Evidence for Climate Change

The Met Office has reliable climate evidence since 1914 – but we can tell what happened before that using several methods.

Ice and Sediment Cores

- Ice sheets are made up of layers of snow, one per year. Gases trapped in layers of ice can be analysed. Ice cores from Antarctica show changes over the last 400 000 years.
- Remains of organisms found in cores from the ocean floor can by traced back 5 million years.

Pollen Analysis

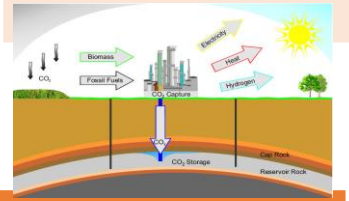
- Pollen is preserved in sediment. Different species need different climatic conditions.

Tree Rings

- A tree grows one new ring each year. Rings are thicker in warm, wet conditions
- This gives us reliable evidence for the last 10 000 years.

Temperature Records

- Historical records date back to the 1850s. Historical records also tell us about harvest and weather reports.



Managing Climate Change

Mitigation

- **Alternative energy production** will reduce CO_2 production.
- **Planting Trees** – helps to remove carbon dioxide.
- **Carbon Capture** – takes carbon dioxide from emission sources is stored underground.
- **International Agreements** e.g. the Paris Climate Agreement.

Adaption

- **Changes in agricultural systems** need to react to changing rainfall and temperature patterns and threat of disease and pests.
- **Managing water supplies** – eg. by installing water efficient devices and increasing supply through **desalination** plants.
- **Reducing risk** from rising sea levels would involve constructing defences such as the Thames Flood Barrier or restoring mangrove forests, or raising buildings on stilts.