

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.

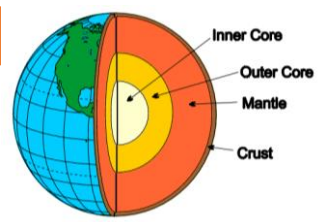
What affects hazard risk?

- 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

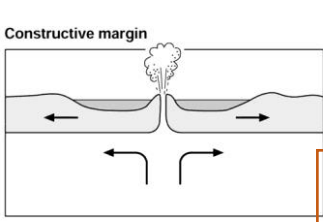
The earth has 4 layers
The core (divided into inner and outer), mantle and crust.



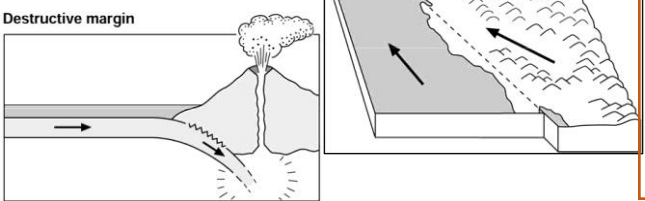
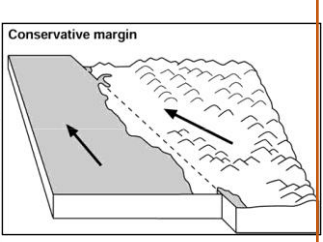
The crust is split into major sections called **tectonic plates**.

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

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..



Earthquakes and Volcanoes

Volcanoes	Earthquakes
<ul style="list-style-type: none"> - 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. 	<ul style="list-style-type: none"> - 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.

Generic Effects of Tectonic Hazards

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

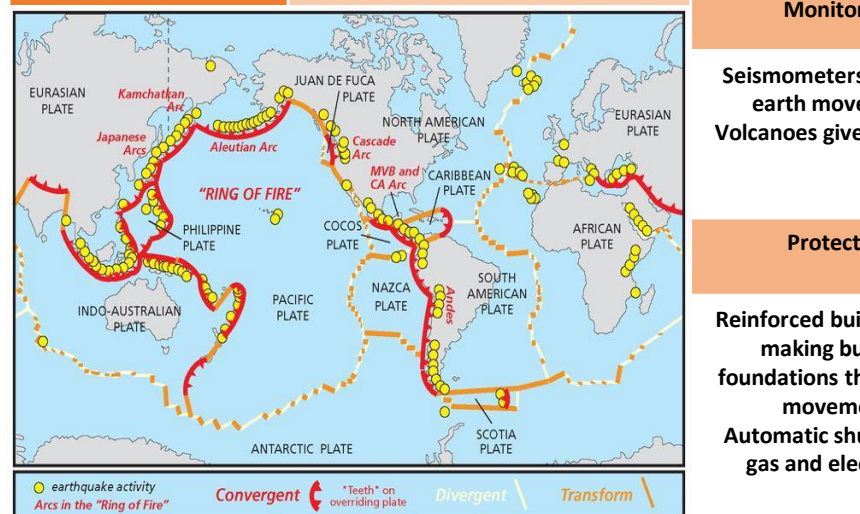
Primary - Earthquakes	Secondary - Earthquakes
<ul style="list-style-type: none"> - Property and buildings destroyed. - People injured or killed. - Ports, roads, railways damaged. - Pipes (water and gas) and electricity cables broken. 	<ul style="list-style-type: none"> - Business reduced as money spent 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
<ul style="list-style-type: none"> - Property and farm land destroyed. - People and animals killed or injured. - Air travel halted due to volcanic ash. - Water supplies contaminated. 	<ul style="list-style-type: none"> - 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.

Generic Responses to Tectonic Hazards

Immediate (short term)	Long-term
<ul style="list-style-type: none"> - Issue warnings if possible. - Rescue teams search for survivors. - Treat injured. - Provide food and shelter, food and drink. - Recover bodies. - Extinguish fires. 	<ul style="list-style-type: none"> - Repair and re-build properties and infrastructure. - Improve building regulations - Restore utilities. - Resettle locals elsewhere. - Develop opportunities for recovery of economy. - Install monitoring technology.

The Challenge of Natural Hazards

Distribution of tectonic activity	Along plate boundaries. On the edge of continents. Around the edge of the Pacific.
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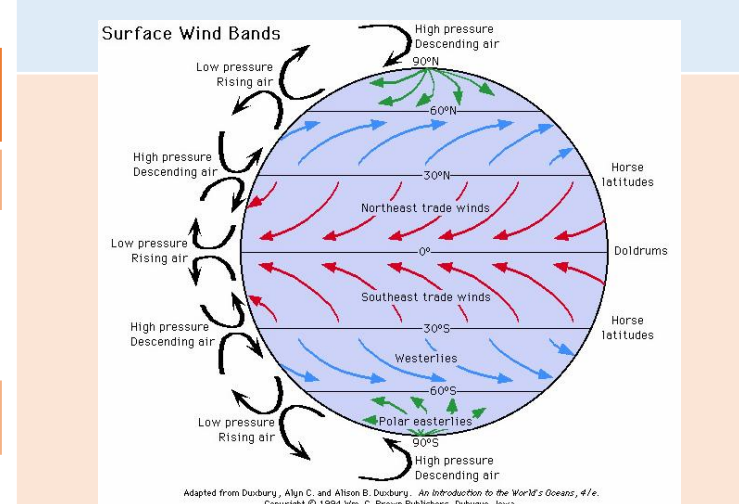
Comparing Earthquakes – Nepal and New Zealand

Nepal Earthquake 2015	New Zealand Earthquake 2010
Social Effects	
<ul style="list-style-type: none"> 8 million people affected. Over 9,000 deaths. 20,000 injured. 3 million made homeless. 7000 schools collapsed. No clean water access causing diseases to spread. No electricity, further hindering the response. 	<ul style="list-style-type: none"> No deaths, only 2 serious injuries. Electricity supply lost, although restored to 90% by 18:00 Water supply was at risk of contamination for 4 days.
Economic Effects	
<ul style="list-style-type: none"> 50% of shops destroyed. Businesses destroyed. Damage to both agricultural and tourism industries. Airport and port damaged. Estimated cost of damage \$5 billion. 	<ul style="list-style-type: none"> Some roads damaged, although few were seriously impacted. Could be classed as 5th most costly in the world with \$4 billion worth of damage and \$1.4bn in insurance pay-outs. Jobs lost as some businesses were damaged beyond repair.
Immediate Responses	
<ul style="list-style-type: none"> Search and rescue teams, medical support and water came from countries such as UK, India and China. Half a million tents provided shelter for the homeless. Helicopters used to rescue those cut off by avalanches or landslides. Medical teams began treating the injured –temporary field hospitals were set up by organisations like the International Committee of the Red Cross. 300,000 migrated from Kathmandu. People from around the world pledged money over their mobile phones. 	<ul style="list-style-type: none"> St Johns ambulance had 16 available within an hour. Electricity repair was a main priority. Website set up by Canterbury Civil Defence to inform people. Australian search and rescue teams operating in Christchurch the day after the quake. (Huge public support with this) More specialist teams arrived from the US, UK and Japan. 1200 police to patrol and help the people. Canterbury Art Gallery designated as a emergency refuge centre. Police provided security cordons and evacuated areas.
Long term responses	
<ul style="list-style-type: none"> June 2015 International conference to seek technical and financial support from other countries. July 2015 some heritage sites open to boost tourism, August 2015 new routes established and Everest reopened for climbers. Stricter controls on building codes. Schools are being rebuilt. 	<ul style="list-style-type: none"> Central Govt agreed to provide finance to rebuild 90% damaged buildings. The Red Cross issued support to families with children who had been displaced to help rebuild their lives.

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

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.



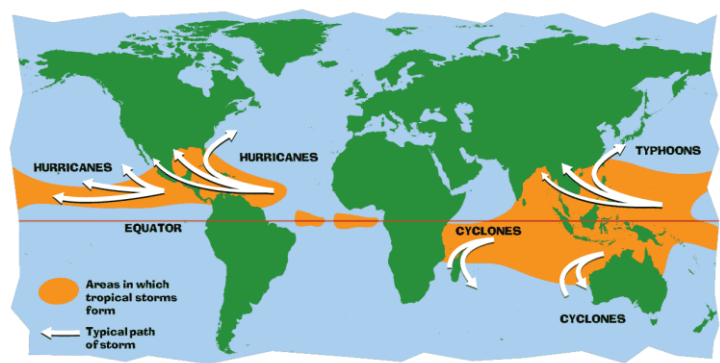
High pressure = dry
Low pressure = wet
As the air heats it rises – causing low pressure. As it cools, it sinks, causing high pressure. Winds move from high pressure to low pressure. They curve because of the **Coriolis effect** (the turning of the Earth)

Reducing the impact of tectonic hazards

Monitoring	Prediction
<ul style="list-style-type: none"> Seismometers measure earth movement. Volcanoes give off gases. 	<ul style="list-style-type: none"> By observing monitoring data, this can allow evacuation before event.
Protection	Planning
<ul style="list-style-type: none"> Reinforced buildings and making building foundations that absorb movement. Automatic shut offs for gas and electricity. 	<ul style="list-style-type: none"> Avoid building in at risk areas. Training for emergency services and planned evacuation routes and drills.

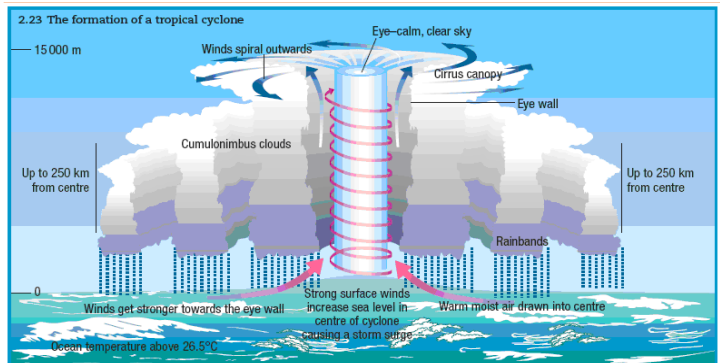
Tropical Storms

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** – lightning 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

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.

Long-term Responses

UN appeal raised \$300 million.
Typhoon warning systems have been improved.
People are now better educated about how to respond.



Prediction Planning Protection

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

4th-5th December 2015 – Storm Desmond

The 4th named storm of the winter of 2015-16. Particularly effected Cumbria. 341.4 mm of rainfall recorded in 24 hrs

Social Effects

3 deaths.
19000 homes flooded across Northern England.
100,000 homes affected by power cuts.
More than 40 schools in Cumbria were closed. Appointments in many hospitals in Cumbria were cancelled as hospitals had no mains electricity.

Economic Effects

Caused £500 million damage in Cumbria.
Landslides and flooding closed some main roads and many bridges were damaged causing extra transport costs for businesses.
The rail route between England and Scotland was closed due to flooding.

Environmental impacts

Large amounts of soil were washed into the rivers, with millions of tonnes of silt transported by rivers and deposited on floodplains

Management strategies

Met Office issued weather warning
Environment agency issued flood warning
Soldiers took supplies to remote areas in the Lake District.
The government gave £50 million to repair damage in Cumbria and Lancashire.
The Cumbria Flood Recovery Fund 2015 helped families who had little insurance .

Managing Climate Change

Mitigation

- **Alternative energy production** will reduce CO₂ 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.

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

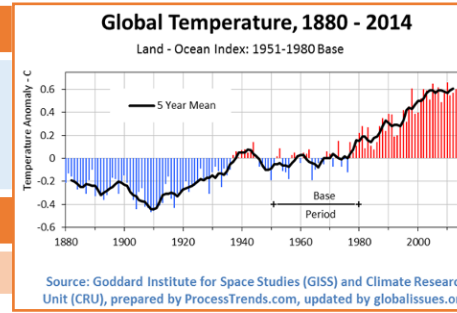
Natural Human

- **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 weather
- 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 be traced back 5 million years.

Pollen Analysis

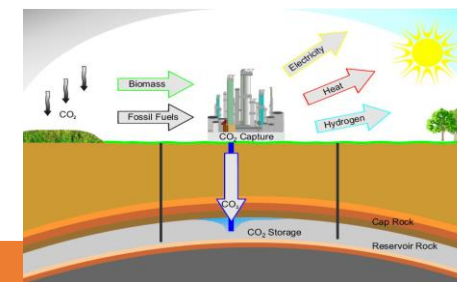
- Pollen is preserved in sediment. Different species need different climatic conditions.

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.



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.