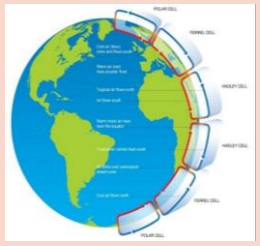
# Topic 1
# Global Hazards

## 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. |



## Climate Zones

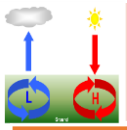
The global circulation system controls temperatures by influencing precipitation and the prevailing winds. This creates distinctive climate zones.

| | |
|---|---|
| **Temperate Climate** | Mid-latitude, 50° - 60° north &south of the Equator. Here air rises and cools to form clouds and therefore frequent rainfall. e.g. UK. |
| **Tropical Climate** | Found along the Equatorial belt, this zones experiences heavy rainfall and thunderstorms. E.g. Brazil. |
| **Polar Climate** | Within the polar zones cold air sinks causing dry, icy and strong winds. E.g. Antarctica. |
| **Desert Climate** | 30° north and south of the equator, sinking dry airs leads to high temperatures without conditions for rainfall. E.g. Libya. |

## High and Low Pressure

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

## What is wind?




Wind is the movement of air from an area of high pressure to one of low pressure.

## Types of wind

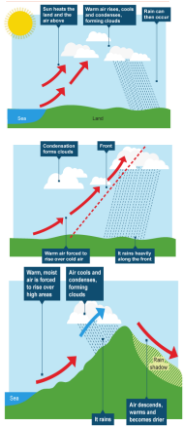
| | |
|---|---|
| **Katabatic Winds** | Winds that carry air from the high ground down a slope due to gravity. e.g. Antarctic. |
| **Trade Winds** | Wind that blow from high pressure belts to low pressure belts. |
| **Jet Streams** | These are winds that are high in the atmosphere travelling at speeds of 225km/h. |

## What is precipitation?

This is when water vapour is carried by warm air that rises. As it gets higher, the air cools and the water vapour condenses to form a cloud. As water molecule collide and become heavier, the water will fall to Earth as precipitation.

## Types of precipitation

| | |
|---|---|
| **Convectional Rainfall** | When the land warms up, it heats the air enough to expand and rise. As the air rises it cools and condenses. If this process continues then rain will fall. |
| **Frontal Rainfall** | When warm air meets cool air an front is formed. As the warm air rises over the cool air, clouds are produced. Eventually steady rain is produced. |
| **Relief Rainfall** | When wind meets mountains, the warm air is forced to rise quickly and cool. This leads condensation and eventually rainfall. When the air descend however, little very rainfall falls, creating a rain shadow. |

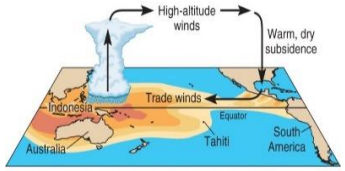


## Distribution of Droughts

Drought can occur anywhere throughout the world but they are more frequent and severe along the tropics of Cancer and Capricorn. Australia and many countries within Africa, such as Ethiopia, suffer from severe drought conditions.

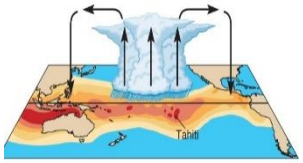
## Causes of Drought: El Nino effect

The El Nino effect is also associated with creating dry conditions.




Normally, warm ocean currents off the coast of Australia cause moist warm air to rise and condense causing storms and rain over Australia.

In an El Niño year (every 2-7 years) the cycle reverses. Cooler water off the coast of Australia reverses the wind direction leading to dry, sinking air over Australia causing hot weather and a lack of rainfall.




## Extremes in weather conditions

**Wellington, New Zealand**
Very high wind speeds (248mkm/h) due to the surrounding mountains funnelling wind.

**Puerto Lopez, Ecuador**
Found along the equator, high temperatures lead to rapid condensation and heavy rainfall.

**The Atacama, Chile**
The Andes mountains block moist warm travelling any further west. This causes rainfall to the east, but a rain shallow to the west.

**Mawsynram, India**
This village see a lot of rain each year (11m per yr). This is due to the reversal of air conditions/directions from sea to land. In the summer, this contributes to monsoons.

## Changing pattern hazards

| | |
|---|---|
| **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. |
| **Droughts** | The severity of droughts have increase since the 1940s. This may be due to changing rainfall and evaporation patterns related to gradual climate change. |

## 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 between the tropics of Cancer and Capricorn and despite varying wind speeds are ferocious storms. Some storms can form just outside of the tropics, but generally the distribution of these storms is controlled by the places where sea temperatures rise above 27°C.

## Formation of Tropical Storms

| | |
|---|---|
| 1 | The sun's rays heats large areas of ocean in the summer. 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 hit land, it loses its energy source (the warm ocean) and it begins to lose strength. Eventually it will 'blow itself out'. |

## Case Study: UK Drought 2012

### Causes

From 2010 to May 2012 most of England received less than 85% of average rainfall, with some areas receiving less than 75%.

| Effects | Management |
|---|---|
| • The harvest in 2011 was poor and more food was imported to avoid shortages.<br>• Wild fires raged over areas of moorlands. | • Permits were granted to allow the water companies to extract water from rivers.<br>• Councils issued hosepipe bans.<br>• There were campaigns to reduce water usage. |

## Case Study: Typhoon Haiyan 2013

### Causes

Started as a tropical depression on 2rd November 2013 and gained strength. Became a Category 5 "super typhoon".

| Effects | Management |
|---|---|
| • Almost 4,000 deaths.<br>• 130,000 homes destroyed<br>• Water and sewerage systems destroyed caused diseases.<br>• Emotional grief for lost ones. | • The UN raised £190m in aid.<br>• USA & UK sent helicopter carrier ships deliver aid remote areas.<br>• Education on typhoon preparedness. |

## The structure of the Earth

| | |
|---|---|
| **The Crust** | Varies in thickness (5-10km beneath the ocean. Made up of serval 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. |

## Convection Currents

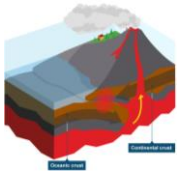
The Lithosphere is divided into tectonic plates which are moving due to convection currents in the asthenosphere.

1. When lower parts asthenosphere heat up they become **less dense** and **slowly rise**.
2. As they move towards the top they cool down, become **more dense** and **slowly sink**.
3. These **circular movements** of semi-molten rock are **convection currents**
4. Convection currents create **drag** on the base of the tectonic plates and this causes them to move.

## Types of Plate Margins

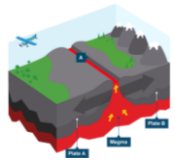
### Destructive Plate Margin

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.



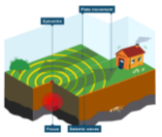
### Constructive Plate Margin

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.



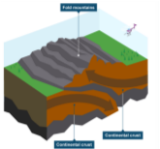
### Conservative Plate Margin

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.



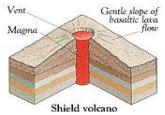
### Collision Zones

Collision zones form when two continental plates collide. Neither plate is forced under the other, and so both are forced up and form fold mountains. These zones are responsible for shallow earthquakes in the Himalayas.

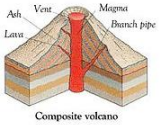


## Types of volcanoes

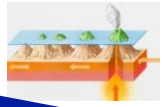
| | |
|---|---|
| **Shield** | Made of basaltic rock and form gently sloping cones from layers of runny lava.<br>Location: hot spots and constructive margins.<br>Eruptions: gentle and predictable |
| **Composite** | Most common type found on land. Created by layers of ash and lava.<br>Location: Destructive margins<br>Eruptions: explosive and unpredictable due to the build of pressure within the magma chamber. |
| **Hotspots** | These happen away from any plate boundaries. They occur because a **plume of magma rises** to eat into the plate above. Where lava breaks through to the surface, **active volcanoes** can occur above the hot spot. E.g. Hawaii. |



Shield volcano



Composite volcano



## Case Study: Haiti Earthquake 2010

### Causes

The earthquake, causes by a conservative boundary, hit 15 miles southwest of the Haitian capital of Port-au-Prince. The initial shock registered a magnitude of 7.0 and was soon followed by two aftershocks of magnitudes 5.9 and 5.5.

**Effects**

- 3 million people were affected by the quake (1/3 of the country's total population).
- 230,000 people died.
- Looting became more prevalent in the absence of sufficient supplies.
- Cholera outbreak.

**Management**

- The EU gave $330 million and the World Bank waived the countries debt repayments for 5 years.
- Bottled water and food were provided by NGOs such as Oxfam and UNICEF.
- The Dominican Republic offered support and accepted some refugees.

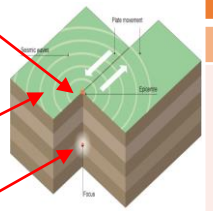
## Causes of Earthquakes

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**.



### Depth of Earthquake

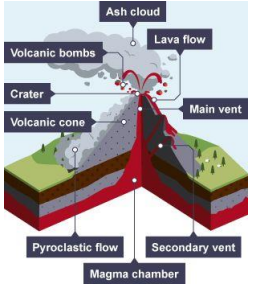
| Shallow Focus | Deep Focus |
|---|---|
| -Usually small and common.<br>-Seismic waves spread and damage wide area. | -Occur on destructive margins.<br>-Damage is localised as seismic waves travel vertically. |

## How do we measure earthquakes?

| Mercalli Scale | Richter Scale |
|---|---|
| • Measures how much damage is caused, based on observations, not scientific instruments.<br>• Base from 'Instrument' and 'Weak' to 'Extreme' and 'Cataclysmic'.<br>• Limitations is that its subjective due to it being based on perception. | • Is a scientific measurement based on the energy released.<br>• Measured by seismometers using measurement from 1 – 10<br>• Logarithmic – each point up the scale is 10 times greater than the one before. |

## 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. |

## Earthquake Management

### Prediction

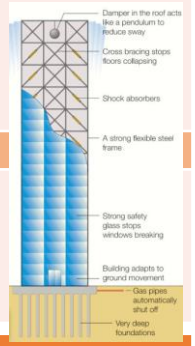
Methods include:

- 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 ideas

| | |
|---|---|
| 1. Counter-weights to the roof to help balance any swaying. | 2. Roof made from reinforced cement concrete. |
| 3. Foundations made from reinforced steel pillars, bail-bearings or rubber. | 4. Windows fitted with shatter-proof glass to reduce breakage. |
| 5. Lightweight materials that cause minimal damage if fallen during an earthquake. | 6. Ensure gas pipes have an automatic shut off to prevent risk of fire. |