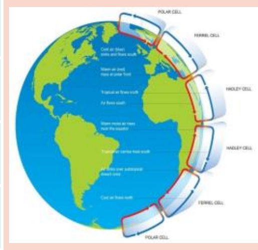
Topic 1
Global Hazards

1.1ai. 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 between 30/40° and 60° to 70° latitude. Air flows pole-wards
Polar cell	Smallest & weakest extends between the poles and the Ferrel cell.



1.1ai Climate Zones

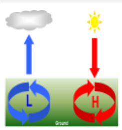
The global circulation system controls temperatures by influencing precipitation and the prevailing winds. This creates distinctive climate zones.

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. Moderate temp and rainfall. [Ferrel Cell]
Tropical Climate	Found along the Equatorial belt, this zones experiences heavy rainfall and thunderstorms. E.g. Brazil. [Hadley cell]
Polar Climate	Within the polar zones cold air sinks causing dry, icy and strong winds. E.g. Antarctica.
Sub Tropical (Desert) Climate	30° north and south of the equator, sinking dry air leads to high temperatures without conditions for rainfall. E.g. Libya. [Hadley cell]

1.1ai High and Low Pressure belts

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

1.1ai What is wind?



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

1.1ai Types of wind

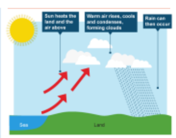
Katabatic Winds	Winds that carry air from the high ground down a slope due to gravity. e.g. Antarctic.
Trade Winds	Wind that blow from high pressure belts to low pressure belts.
Jet Streams	These are winds that are high in the atmosphere travelling at speeds of 225km/h.

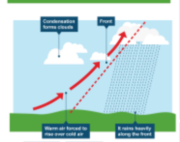
1.1ai What is precipitation?

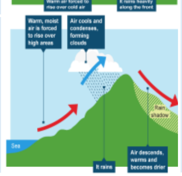
This is when water vapour is carried by warm air that rises. As it gets higher, the air cools and the water vapour condenses to form a cloud. As water molecule collide and become heavier, the water will fall to Earth as precipitation.

1.1ai 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 to condensation and eventually rainfall. When the air descends however, very little rainfall falls, creating a rain shadow.





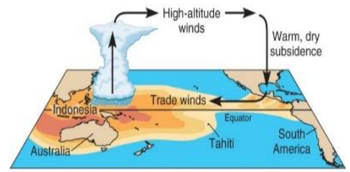


1.1aiii Distribution of Droughts [<ave or no rainfall in an area]

Drought can occur anywhere throughout the world but are more frequent between the tropics of Cancer and Capricorn. Many countries in Africa suffer from severe drought, such as Ethiopia but Australia, China & Mexico also suffer.

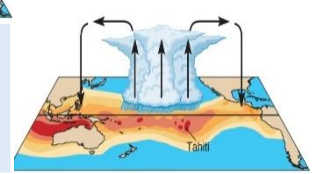
1.1aiii Making Drought worse: El Nino effect

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 5-7 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. Central America gets wetter.



1.1aii Extremes in weather conditions

Wellington, New Zealand [windy] Very high wind speeds (248mkm/h) due to the surrounding mountains funnelling wind.	**Vostok, Antarctica [coldest]** -89.2 temperature recorded in 1983. 3500m above sea level. Windy too!
The Atacama desert, Chile [driest] The Andes mountains block moist warm travelling any further west. Gets 0.1mm per year, some parts have had 0 rainfall in last 400 years	**Mawsynram, India [wettest]** 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.

1.1aiii Changing pattern of these 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. Others think it is a cycle.
Droughts	The severity of droughts has increased since the 1940s. Possibly due to changing rainfall & evaporation patterns related to gradual climate change.

1.1aiii 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.

1.1aiii Formation of Tropical Storms

1	The sun's rays heat large areas of ocean in the summer & autumn. This causes warm, moist air to rise over these particular spots.
2	Once the temperature is 27°, the rising warm moist air results in low pressure. This cools, condenses & clouds form eventually it 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 (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. Typical storms last 6-14 days

1.1b Case Study: UK Drought 2012

Causes

04/2010-05/2012 UK got only 55-95% of usual rainfall. Dry winds from East Europe dominated (usually wet Atlantic ones); higher temps so more evap.

Consequences	Management
*heat strokes and dehydration. *Rail network disrupted *crop yields were low – food shortages, ↑ prices *wildfires; wildlife issues	*NHS and media gave guidance to the public. *Limitations placed on water use (hose pipe ban). *Speed limits imposed on trains *Water Co's allowed to take water from rivers

1.1b Case Study: Typhoon Haiyan 2013

Causes

Started as a tropical depression on 2/11/13 and gained strength. Became a Category 5 "super typhoon". Sea temp 26.5°; 60m deep ocean

Consequences	Management
*6,300 deaths. 11 mill pple affected inc 0.5 mill homeless *130,000 homes destroyed *Water and sewerage systems destroyed caused diseases. *Emotional grief for lost ones. *flash floods & landslides	*UN raised £190m in aid. *USA & UK sent helicopter carrier ships deliver aid remote areas. *Education on typhoon preparedness. *Australia $28 mill staff; hygiene kits, shelters, water containers

1.2ai The structure of the Earth

The Crust (lithosphere layer)	Continental & oceanic. Varies in thickness (7km beneath the ocean, 35 below land). Made up of several large plates.
The Mantle (asthenosphere layer)	Widest layer (2900km thick). The heat and pressure means the rock is in a semi liquid state. Convection currents operate here.
The Inner and outer Core	Hottest section (5000 degrees). Mostly made of iron and nickel; 4x denser than the crust. Inner section is solid whereas outer layer is liquid.

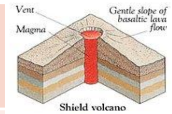
1.2ai Convection Currents

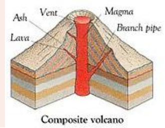
Plate movement theory partly based on these c.c's

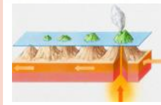
1	Radioactive decay of some of the elements in the core and mantle generate a lot of heat.
2	When lower parts asthenosphere heat up they become **less dense** and **slowly rise**.
3	As they move towards the top they cool down, become **more dense** and **slowly sink**.
4	These **circular movements** of semi-molten rock are **convection currents. They are partly responsible for plate movement**
OR	Ridge push – new crust rises as it is warm and thin, pushes older crust away from the ridge. Slab pull old plate sinks

1.2aiii Types of volcanoes

Shield	Made of basaltic rock and form gently sloping cones from layers of runny lava. Location: hot spots and constructive margins. Eruptions: gentle and predictable
Composite	Most common type found on land. Created by layers of ash and (acidic) lava. Location: Destructive margins 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.

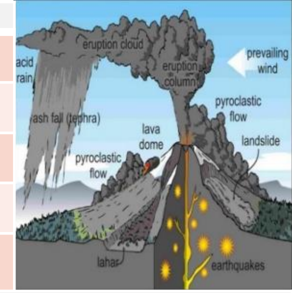






1.2aiii Volcanic Hazards

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/off the side of 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.



1.2c 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.

1.2b Case Study: LIDC Nepal earthquake, April 25th 2015 7.8 magnitude

Causes
- The Indian and Eurasian plates push together 20mm per year (collision). Pressure builds
- Focus = 15km below surface. The crust moved 3m in some places.

Consequences
Landslides 19009 injured 8635 killed
$10 billion damage
180 buildings reduced to rubble in Kathmandu
Airport damaged; other transport infrastructure too
Secondary impacts: homelessness, lack of health facilities; accessing remote areas

Responses
NGOs Red Cross & Oxfam sent aid
India – sent blankets, food, medical supplies

Cash for Work projects set up – survivors paid to rebuild own communities
BUT: efforts hampered by airport closure and damaged roads

1.2c Earthquake Management

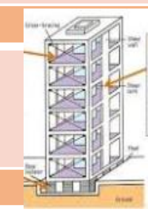
You can't stop earthquakes, so earthquake-prone regions follow these three methods to reduce potential damage:

1. PREDICTING (and then warning people via social media or TV)

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 detects and reports this)
- Seismometer
- Scientists also use seismic records to predict when the next event will occur.

2. EDUCATING

Methods include:
*earthquake drills
*drop, cover, hold on
*earthquake back packs filled with emergency supplies



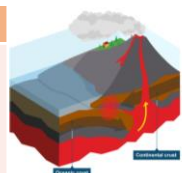
3. ADAPTING BUILDINGS

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.

1.2aii Types of Plate Margins

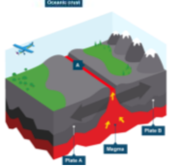
Destructive Plate Margin

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.



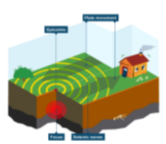
Constructive Plate Margin

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



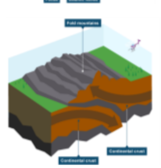
Conservative Plate Margin

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 that 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.



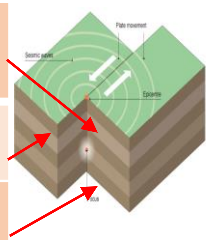
1.2aiii Causes of Earthquakes

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 and 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. -Seismic waves spread laterally and damage wide area.	-Occur on destructive margins. -Damage is localised as seismic waves travel vertically.

1.2aiii How do we measure earthquakes?

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