



UNIT 2: WEATHER HAZARDS AND CLIMATE CHANGE

THE UK'S CLIMATE

Latitude: The UK is located at 50-60°N. Solar radiation is less direct than at the equator, meaning less heat energy.

Prevailing wind: South-westerly brings warm, moist air and therefore more rainfall in SW England and Wales.

Air masses: Five air masses influence the UK climate, resulting in changeable weather conditions.

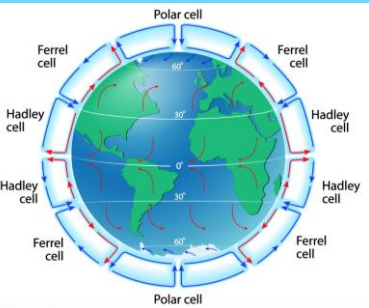
Continentality: Surrounded by sea, the UK experiences less extreme temperature variations than inland areas.

Seasonality: Four distinct seasons. Axial tilt means the sun is more concentrated in the summer, bringing more heat energy to the UK and therefore warmer temperatures.

GLOBAL CLIMATE SYSTEMS

GLOBAL ATMOSPHERIC CIRCULATION

Areas at different latitudes receive different amounts of solar radiation. There is a surplus at the equator, and a deficit at the poles. The GAC redistributes this heat energy.



Hadley cell: Warm air rises at the equator, causing low air pressure. As the air reaches the edge of the atmosphere, it travels north/south towards the poles and starts to cool, sinking at 30°N/S leading to high air pressure.

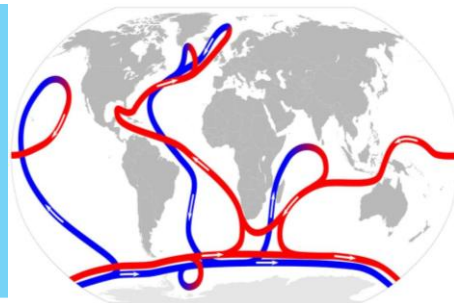
Polar cell: Cold air descends at the poles (90°N/S) resulting in high air pressure. As it travels towards the equator, it warms up and rises at 60°N/S, forming low air pressure.

Ferrel cell: Warm air from the tropics and cold, polar air meet around 60°N/S. Warmer air is lighter and rises, creating low pressure at the surface.

OCEAN CURRENTS AND THE NORTH ATLANTIC DRIFT

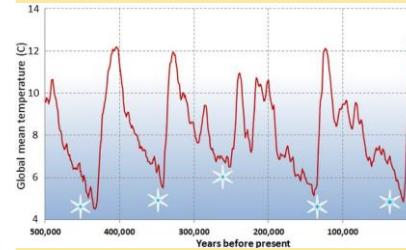
Heat from the tropics can be transferred to the cold, polar regions by large-scale water movements within the oceans. This process is known as **thermohaline circulation** and is influenced by both ocean temperatures (thermo) and the salinity (saltiness) of the water. Warm currents transport warm water from the equator towards the poles, and cold currents take colder water towards lower latitudes.

The **North Atlantic Drift (or Gulf Stream)** ocean current flows across the Atlantic Ocean, bringing warm water from the Gulf of Mexico. This results in milder temperatures in the west of the UK.



NATURAL CLIMATE CHANGE: CAUSES AND EVIDENCE

The Earth has experienced natural fluctuations in its climate between glacials (cold period) and interglacials (warm periods).



Orbital changes: Milankovitch cycles (eccentricity, obliquity and precession) result in natural warming (interglacial) and cooling (glacial) periods.

Solar variation: There can be fluctuations in the amount of radiation produced by the sun. If there is a high amount emitted, temperatures will increase. Relatively short-term.

Volcanism: Volcanic eruptions release large amounts of dust containing gases such as sulphur dioxide. These can block incoming solar radiation, resulting in cooler temperatures. This has a short-term effect on the world's climate, or may be localised.

The **evidence** of natural climate change is varied, with fossilized pollen records and ice cores giving us insights into global climate stretching back as far as 240 million years (pollen) and 400,000 years ago (ice) respectively. Other evidence includes historical sources such as paintings, weather diaries and newspaper reports, as well as tree rings, the colour and width of which tells us about past climate conditions.

HUMAN CLIMATE CHANGE

ENHANCED GREENHOUSE EFFECT

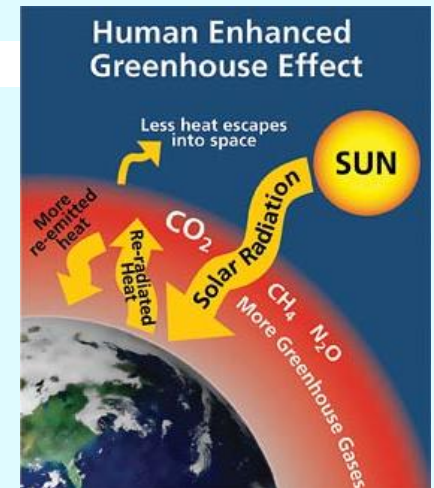
Greenhouse gases, and the 'greenhouse effect', are vital for retaining heat within our atmosphere and keeping the Earth at a habitable temperature. The enhanced greenhouse effect, however, has resulted from human activity and increase greenhouse gas emissions. It causes more heat to be trapped in the atmosphere, resulting in rising temperatures. Causes of the enhanced greenhouse effect include:

Transport: Cars have become more affordable and ownership has increased. Long haul flights have reduced in price, increasing popularity. More fuel burnt as a result of both.

Energy: Growing demand due to increases in population and technology. Main source is fossil fuels, which produce greenhouse gases when burned to create electricity.

Agriculture: Rice production and cattle ranching release methane into the atmosphere. Deforestation for agriculture means fewer trees to remove CO₂ from the atmosphere.

Industry: Major consumer of energy as it meets rising demands for goods production.



IMPACTS OF CLIMATE CHANGE ON PEOPLE AND THE ENVIRONMENT

The impacts of climate change are varied, with localised and global effects. Some of the world's poorest nations will be disproportionately affected, as they are often dependent on industries like agriculture and have fewer resources to mitigate and adapt to the impacts.

Changing crop yields: Global crop yields of soy, maize, rice and wheat are decreasing as a result of climate change. As the availability of these decreases, food prices will rise as demand for these staple foods remains high. May lead to malnutrition in developing countries.

Rising sea levels: Rising temperatures are leading to thermal expansion, where the molecules within water expand in size and thus the volume of water increases. Rising sea levels will affect 200 million people by 2100, particularly affecting low-lying areas e.g. Maldives.

Retreating glaciers: Glaciers in locations such as the Himalayas are melting quickly as a result of rising temperatures. Due to the volume of water, this will affect ocean currents and exacerbate rising sea levels, as well as reduce freshwater supply for drinking and irrigation locally.



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TROPICAL CYCLONES

CAUSES OF TROPICAL CYCLONES

Tropical storms form between 5-30° N/S of the equator. They cannot form on the equator as the Coriolis effect is too weak.

1. When ocean surface water reach at least 27°C due to solar heating, the warm air above the water rises quickly, causing an area of very low pressure.
2. As the air rises quickly, more warm and moist air is drawn upwards from above the ocean, creating strong winds.
3. The rising, warm air spirals upward and cools. The water vapour it carries condenses and forms cumulonimbus clouds, which make up the eye wall of the storm. Cooling air sinks in the centre of the storm, creating calm conditions in the eye.
4. With trade winds blowing in the opposite direction and the rotation of the earth involved (Coriolis effect), the storm will eventually start to spin. Once it reaches a speed of 74mph or greater, it is classified as a tropical cyclone.

LOCATED EXAMPLES: HURRICANE SANDY AND TYPHOON HAIYAN

Hurricane Sandy, USA (2012)

A Category 3 storm, Hurricane Sandy hit the eastern coast of the USA in October 2012. Impacts were smaller and short-term in nature due to the preparedness of the country.

- 150 deaths
- \$65bn in damage to property/infrastructure
- NY stock exchange closed for 1 day
- 1.5bn litres of sewage released into river
- Prime Hook Nature Reserve damaged

- FEMA resources put into place before the hurricane e.g. hurricane tracking, evacuation then assessed extent of damage and prioritisations following the storm
- 17,000 Red Cross workers provided food, water and shelter to those in need
- AmeriCare raised \$7.1 million in aid

Typhoon Haiyan, The Philippines (2013)

A Category 5 storm, Typhoon Haiyan was one of the worst in the country's history. Preparation and responses were inadequate due to a lack of resources, meaning the impacts were far more destructive and have taken many years to recover from.

- 6000 deaths
- 500,000 displaced (made homeless)
- Mangrove forest destroyed
- \$2bn damage cost
- Damage to infrastructure e.g. Tacloban airport

- Government declared an emergency, meaning other countries were called in to support them
- UN co-ordinated a £190m relief effort
- Community effort to rebuild houses
- Save the Children distributed rice seeds so farmers could plant crops, educated children about sanitation

In the USA, the main impacts were **economic** as the storm affected the global financial hub of New York City and damaged expensive property/infrastructure. By contrast, the main impacts in The Philippines were **social** with a high number of lives lost. Although the cost of the damage in the USA was greater, they were better positioned to deal with this as one of the most developed economies in the world. However, \$2bn of economic damage in The Philippines would have been more difficult for them to cope with, especially as the agriculture their economy was dependent on was devastated by the tropical cyclone.

DROUGHT

CAUSES OF DROUGHT

Drought is an acute water shortage associated with long periods of rainfall deficiency. There are two main causes of drought: **meteorological** and **hydrological**. Meteorological drought occurs when the amount of precipitation received is less than the average, whilst hydrological drought is caused decreased precipitation affecting water supply e.g., rivers, reservoirs and groundwater.

CAUSE	EXAMPLE	EXPLANATION
Natural variations in atmospheric conditions (meteorological)	El Niño or La Niña	<ul style="list-style-type: none"> • Prolonged high-pressure systems reduce evaporation and the amount of water vapour in the atmosphere. This will mean there is less precipitation and more chance of drought. • El Niño is a climate pattern causing unusual <u>warming</u> in the eastern Pacific. This disrupts storm patterns and is thought to create drought in Indonesia/Australia. La Niña is the opposite of this, causing temperatures in the Pacific to <u>decrease</u>, again disrupting storms and leaving North and South America prone to drought.
Agriculture (hydrological)	Cotton farming in Kazakhstan caused Aral Sea to shrink	<ul style="list-style-type: none"> • Intensification of farming may involve unsustainable use of irrigated water in crop production. This leads to <u>over-abstraction</u> of water, where more water is taken from water sources than is replenished.
Dam building (hydrological)	Dam building on the Euphrates in Turkey has caused less water to flow into Syria/Iraq	<ul style="list-style-type: none"> • Large areas of land behind a dam are flooded to create a reservoir, an artificial store of water that may be used for consumption or energy production. This greatly reduces the amount of water flowing downstream, which can lead to shortages and/or drought.
Deforestation (hydrological)	Nigeria has the world's highest rate of deforestation	<ul style="list-style-type: none"> • Cutting down trees reduces the soil's ability to hold water, causing land to dry out which can result in droughts. • Deforestation leads to reduced tree cover, meaning that there is less transpiration. As a result, it reduces the amount of moisture in the atmosphere leading to less rainfall.

LOCATED EXAMPLES: AUSTRALIA AND NAMIBIA

Australia (2015)

Less severe impacts due to the effectiveness of the responses. Being a developed country, it had more capacity to cope.

- IMPACTS**
- Half of farmers had their income cut by 50%.
 - 15% increase in suicide risk on young male farmers.
 - 9 people killed and 900 buildings destroyed by fires.
 - Drop in GDP of around 1%.
 - 300,000 hectares of land burnt during bush fires

RESPONSES

- 1/3 citizens got rainwater holding tanks.
- \$6 billion on desalination plant which has seen limited use.
- Australian Red Cross trained farmers to adapt to drought.
- Government offered \$333 mil but had eligibility requirements.
- Drought Angels organised convoy of 130 lorries to carry cattle feed.

Namibia (2011)

More severe impacts due to the ineffectiveness of responses. 70% of Namibians are reliant on agriculture for their livelihood, so droughts can be particularly devastating. The impacts can combine to create a vicious cycle and can result in many deaths, especially amongst the most vulnerable.

- IMPACTS**
- 780,000 citizens suffered from malnutrition.
 - GDP dropped from \$12billion to \$10.7 billion.
 - Land changing from savannah grasslands to desert.
 - Lack of clean water led to outbreaks of cholera.
 - Mass migration to towns in search of work.

RESPONSES

- UNICEF and Red Cross aimed to raise \$8.5 million.
- Government pledged \$13 mil, Algeria \$1 mil (food), USA \$8.7 mil.
- Lutheran Church and soup kitchens provided basic food and clean water to 164,000.
- Government provided food to 755,000 and rebuilt 300 boreholes.