THE CHALLENGE OF NATURAL HAZARDS: TECTONIC HAZARDS

WHAT AFFECTS HAZARD RISK?

Poverty: Land is cheaper in risky places.
Urbanisation: People may be forced to live on steep slopes or flood plains.
Farming: Farmers choose to live on floodplains or volcano slopes because of fertile land.
Climate change: More extreme weather events in the future.

PLATE TECTONIC THEORY

Continental drift: Crust broken into plates that move (Wegner) – used to be one 'super-continent' – Pangea.
Convection currents: Theory that plates moved due to movement of magma in the mantle (widely discredited now).
Ridge push: New crust formed at constructive margins rises to form ocean ridges – older seafloor on either side slides away.
Slab pull: At subduction zones older denser plates sink into the mantle – pulling newer/less dense bits of plate with it.

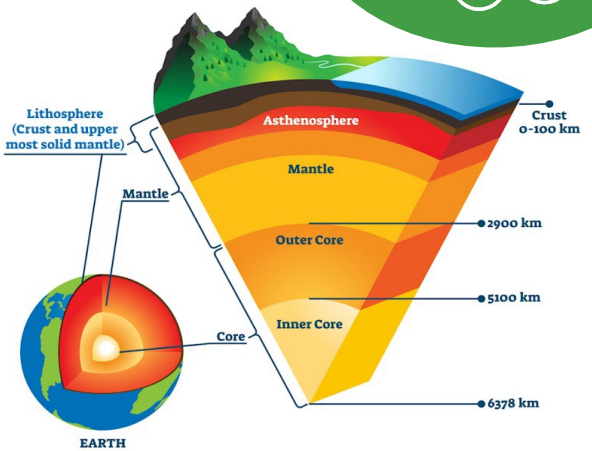
LAYERS OF THE EARTH

Crust: Thinnest outermost layer.
Mantle: Thickest layer (approx. 2,900km).
Core: Inner core is solid; outer core is liquid.
Lithosphere: ***The crust and upper (rigid) part of the mantle).***
Asthenosphere: ***Denser weaker layer of the mantle (100-400km below Earth's surface) – semi-molten.***

TYPES OF CRUST

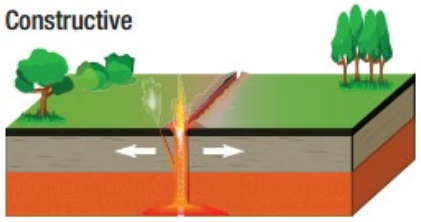
Continental:
- 20-200km thick
- Less dense
- Mainly granite
- Up to 3.8 billion years old

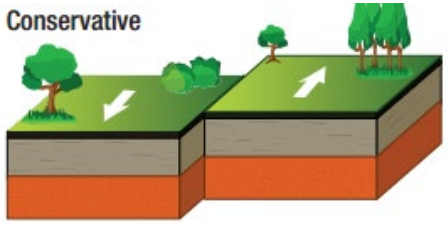
Oceanic:
- 5-10km thick
- Very dense
- Mainly basalt
- Less than 200 million years old



TYPES OF PLATE MARGIN (BOUNDARY)

Destructive: When continental and oceanic plates move towards each other. The denser oceanic plate is subducted under the continental plate forming an ocean trench, and the continental plate folds to form mountains – earthquake and volcanoes occur here.
Constructive: When plates move apart magma rises to the surface and cools to form new land, e.g. a mid-ocean ridge, which can cause volcanoes and earthquakes.
Conservative: When two plates slide past each other, either in opposite directions, or in the same direction but at different speeds. The plates can stick and jolt free causing earthquakes. There is no rising magma so no earthquakes.





THE CHALLENGE OF NATURAL HAZARDS: TECTONIC HAZARDS

PRIMARY IMPACTS

The direct impacts (caused either by the earth shaking or a volcano erupting) – they happen during or immediately after the event, e.g. loss of life and numbers injured, buildings destroyed, transport infrastructure damaged, water/gas pipes breaking, electricity cables falling down; volcanoes – ash clouds covering everything, lava/ash contaminating water supplies.

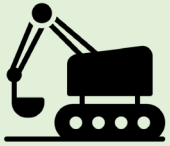
SECONDARY IMPACTS

The indirect impacts (caused by the primary impacts) – they happen in the coming hours, days and weeks, e.g. tsunamis and landslides, communities being cut off (from damaged roads), outbreaks of waterborne diseases (from contaminated water), fires and power cuts (from broken cables).
BUT, also increase in tourism after volcanic eruptions, e.g. Iceland.

IMMEDIATE RESPONSES

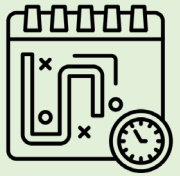
Emergency aid/ assistance given within the first few hours/days – vital to reduce death toll, e.g. search and rescue, medical care such as pain relief and emergency surgery, temporary shelter, providing food and clean water.

LONG-TERM RESPONSES



Take place in the weeks and months after – focus on rebuilding and helping people return to normal lives, e.g. restoring essential utilities, repairing/ rebuilding domestic and commercial buildings, repairing transport links. Also measures to reduce future damage.

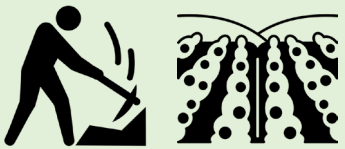
MITIGATING TECTONIC HAZARDS – MP3



Monitoring: Using scientific equipment to detect warning signs, e.g. measuring changes in temperature and bulges in the volcano dome as magma rises, monitoring seismic Activity.
Prediction: Using historical evidence/live data to estimate when a tectonic hazard might happen, e.g. historical records show where earthquakes might occur, particularly if pressure is building up after no recent activity.
Protection: Designing buildings/structures to withstand tectonic hazards, e.g. shock absorbers at the base of tall buildings to make them sway, cross-bracing and automatic window shutters.
Planning: Identifying and avoiding places most at risk and preparing for a disaster, e.g. drawing up hazard maps, setting up 'no-go' areas, practising earthquake drills, stocking up on food, water and fuel, and knowing where to evacuate to.

WHY LIVE IN TECTONIC AREAS?

Geothermal energy: Hot magma in rocks heats up steam – used to drive turbines at power stations.
Mining: Volcanic are rich in minerals – valuable resources and creates jobs.
Farming: weathered lava releases minerals – nutrient-rich soil.
Tourism: Tourists visit to see eruptions, geysers and relax in hot springs.



THE CHALLENGE OF NATURAL HAZARDS: WEATHER HAZARDS

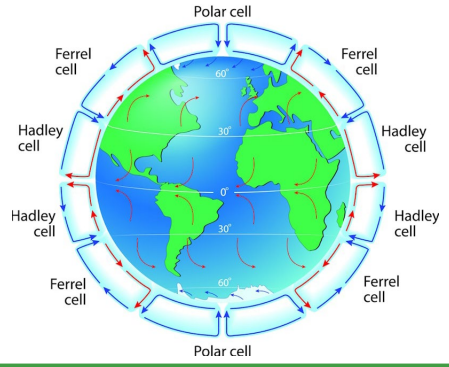
GLOBAL ATMOSPHERIC CIRCULATION

3 cells operate circulating air through the troposphere – whole system is driven by the equator.

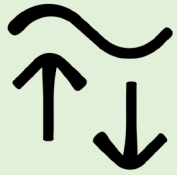
Hadley cell: Air rises at the equator (creates low pressure and rainfall) – when it reaches the atmosphere it can't go any further to travels north or south, then cools and falls creating low pressure and dry conditions at 30°.

Ferrel cell: Air descends at the tropics as it is pulled down by the adjacent air in the Hadley cell. Here the air is driven by the Hadley and Polar cells.

Polar cell: At around 60° this warm air rises, leading to clouds and rain. The air will then flow back to the poles.



PRESSURE BELTS

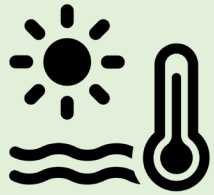


Descending air = high pressure = no clouds and rain.
Rising air = low pressure = clouds and rain.
Poles – high pressure = dry.
60° – low pressure = wet, e.g. the UK.
Tropics – high pressure = dry (home to hot deserts).
Equator – low pressure = very wet (home to tropical rainforests)

TROPICAL STORMS

Form within the tropics between 5 and 30 degrees north and south (not actually along the equator).
Hurricanes: Atlantic and Eastern Pacific Oceans.
Typhoons: West of the North Pacific Ocean.
Cyclones: Indian and South Pacific Oceans.

STAGES OF A TROPICAL STORM



1) Ocean needs to be at least 27°C (to a depth of 60-70m).
2) Air is heated and warm air rises rapidly, drawing in moisture, causing strong winds.
3) Rising air cools and condenses to form tall cumulonimbus clouds – this releases latent heat.
4) The winds start to spin upwards due to the Coriolis effect (the effect of the earths axis).
5) Centre of the storm = eye – calm drier conditions.
6) Trade winds steer storm towards the land.
7) Once it makes landfall the storm loses its source of power – this is why most storm damage happens by the coast.

EXTREME WEATHER IN THE UK

- Prolonged rainfall
- Strong winds (named storms)
- Droughts and heatwaves
- Extreme cold

MANAGING EXTREME WEATHER IN THE UK

Flooding: Environment Agency monitors river levels and gives warnings, flood barriers installed.
Names storms: Met Office issues warnings, travel companies cancel services, high bridges closed, etc.
Droughts and heatwaves: Water companies can place restrictions on use if needed.
Extreme cold: Local councils grit roads.

CLIMATE CHANGE IN THE UK

- The top 10 warmest years on record have occurred since 2002
- Six of the 10 wettest years on record have occurred since 1998
- Fewer very cold days

THE CHALLENGE OF NATURAL HAZARDS: WEATHER HAZARDS

PRIMARY IMPACTS

The direct impacts (caused either by the strong wind, heavy rain or storm surges) – they happen during or immediately after the event, e.g. damage to and destruction of buildings, loss of life through drowning (90% of deaths in tropical storms), power lines blown down, crops washed away, and huge storm surges.

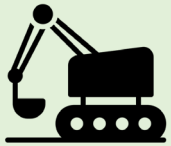
SECONDARY IMPACTS

The indirect impacts (caused by the primary impacts) – they happen in the coming hours, days and weeks, e.g. thousands of people losing their homes and becoming homeless, outbreaks of waterborne disease, loss of crops or fishing boats could lead to a loss of income and affect food supplies, shops could be shut due to a loss of power, education may be disrupted by schools closing.

IMMEDIATE RESPONSES

Emergency aid/ assistance given within the first few hours/days – vital to reduce death toll, e.g. search and rescue, medical care such as pain relief and emergency surgery, temporary shelter, providing food and clean water.

LONG-TERM RESPONSES



Take place in the weeks and months after – focus on rebuilding and helping people return to normal lives, e.g. restoring essential utilities, repairing/ rebuilding domestic and commercial buildings, repairing transport links. Also measures to reduce future damage.

MITIGATING TECTONIC HAZARDS – MP3

Monitoring: Using satellites and aircraft to track the size, temperature and moisture levels of storms, as well as and air pressure.

Prediction: Using super-computers to predict where the storm will hit using a track cone. Computers are also used to give out advanced warnings, e.g. Hurricane Watch (48hr warning) and Hurricane Warning (36hr warning).

Protection: Reinforcing homes, e.g. window shutters, securing roofs and doors with metal straps, building homes on stilts to protect from flooding, building cyclone shelters, constructing storm drains to remove excess rainfall, building sea walls to protect against storm surges, and planting mangrove forests to absorb excess water.

Planning: Raising awareness about what to do in a tropical storm, e.g. Hurricane Preparedness Week (USA), assembling a disaster supply kit, stocking up on food, water and fuel, and knowing where to evacuate to.

HOW WILL CLIMATE CHANGE AFFECT TROPICAL STORMS?

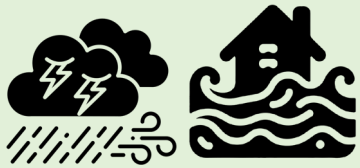
More frequent and intense tropical storms (category 4/5 storms)…

Global warming → ocean thermal expansion of the oceans → sea level rise.

Higher storm surges → low-lying coastal areas flooded.

Storm surges are the most deadly hazard related to tropical storms!

Warmer air in the atmosphere can hold more moisture → heavier rainfall → more destructive flooding during tropical storms.



THE CHALLENGE OF NATURAL HAZARDS: CLIMATE CHANGE

QUATERNARY PERIOD

2.6 million years ago to the present day.
Overall period of cooling!

Glacials:
Cooler periods – UK covered in ice last 100,000 years).

Interglacials:
Warmer periods (last 10,000 years).

EVIDENCE OF CLIMATE CHANGE

Recent:
- Melting sea ice
- Sea level rise
- Seasonal patterns (e.g. birds migrating, plants flowering

Historic:
- Tree rings
- Fossil pollen
- Ice cores
- Observing ocean sediment

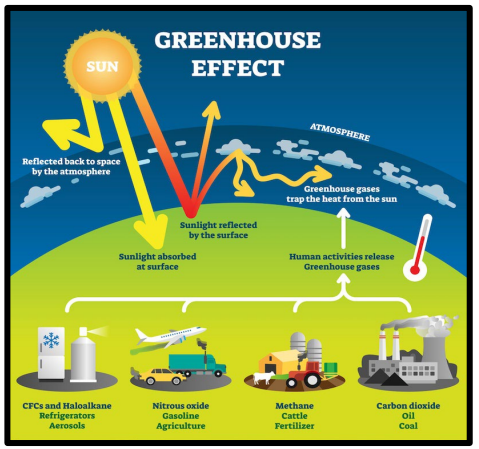
GREENHOUSE EFFECT

The Sun's infrared heat rays enter the Earth's atmosphere…

Short-wave radiation: Most solar radiation is able to past through it to warm up the earth's surface.

Long-wave radiation: The heat given off by the earth's surface.

Greenhouse gases form a blanket within the atmosphere that traps long-wave radiation heat.



NATURAL CAUSES

Orbital changes:
- Eccentricity
- Axial tilt
- Precession

Solar output: Sunspots – dark patched on surface…
- Maximum sunspots = give off more heat
- Few sunspots = colder climate

Volcanic activity: Eruptions can block out sun (temporary effect)

HUMAN CAUSES

Greenhouse gases are released into the atmosphere by human activity – have increased since industrialisation…

Carbon dioxide: From burning fossil fuels and deforestation.

Methane: From rotting organic matter, burning biomass, agriculture (cattle farming).

Nitrous oxides: From fertilisers, sewage treatment plants and vehicle exhausts.

MITIGATION STRATEGIES

Reducing or preventing greenhouse gas emissions…
- Alternative energy sources that don't emit CO2
- Afforestation to create carbon stores
- Transport strategies, e.g. investing in public transport, cycle path networks, park and ride and car share schemes, and EV charging networks

ADAPTATION STRATEGIES

Responding to the impacts of climate change by adjusting how people live or work
- Farming techniques
- Water management
- Flood defences for low-lying areas, e.g. sea walls, tidal barriers, homes on stilts

INTERNATIONAL AGREEMENTS

Paris Accord: Agreement to limit warming to 1.5°C above pre-industrial levels – signed by 195 countries.