Global atmospheric circulation:

Insulation is greater at the equator than poles = temp differences = air pressure differences
Winds transfer heat away from equator

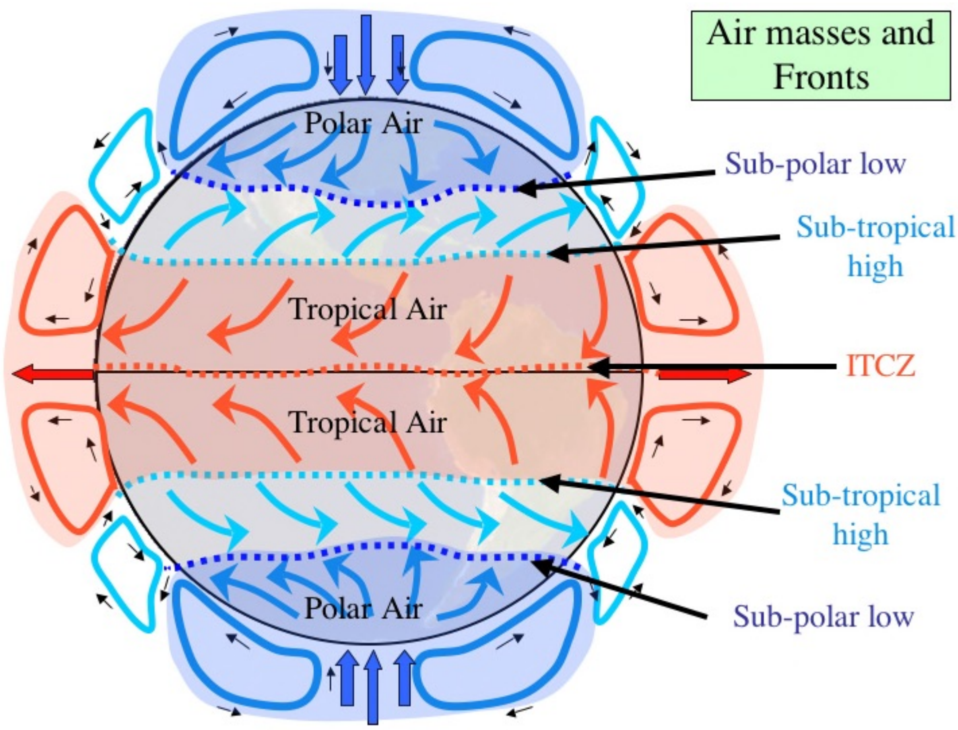
1. At 0 degrees, high insulation = low pressure belt (Hadley cells)
2. Cool & dry air makes high pressure belt at 30 degrees (Ferrell cells)
3. Air moves as surface winds (towards equator = trade wind, towards poles = westerlies)
4. At 60 degrees, winds meet & warm air rises = frontal rain (in a low pressure belt via Ferrell cells)
5. At 90 degrees, high pressure belt is formed (Polar cells)

Ocean currents: movements of water, transfer thermal energy from warm -> cool regions
Surface currents transfer heat away from equator (e.g. Gulf Stream heats Europe)

Deep ocean currents due to variations in water density (water freezes at poles & becomes salty = denser, then sinks so warm water flows at the surface = current) = thermohaline circulation

Varying climates:

Arid: sinking air from Hadley & Ferrell cells = low rainfall, high temp: desert
Polar: sinking air from Polar cells = little rainfall, low temp: polar
Tropical: rising air from Hadley cells = high rainfall, high temp: tropical



Natural climate change:

Climate change = change in weather patterns over long period

Quaternary period: 2.6 mil years ago -> present, shifts between glacial & interglacial eras

Natural causes of climate change:

Orbital changes:
Stretch: earth's orbit around sun changes from circle -> oval (96k years)
Tilt: earth axis tilts during orbit of the sun (41k years)
Wobble: axis of earth wobbles (22k years)
More solar radiation = warmer

Volcanic activity:
Eruptions eject ash, particulates reflect sun's rays = global dimming eg 1816 'year without a summer'

Solar output:
Cycles of 11 years, reduced output = cooler e.g. Maunder Minimum coincided with ice age

Asteroid collisions:
Collisions = dust ejected, particulates prevent sun ray's hitting earth = global cooling e.g. Younger Dryas 12k years ago

Evidence:

Tree rings: thicker annual ring = warmer growing temps
Ice cores: CO_2 measured (more=warmer)
Historical records: diaries & paintings (show early harvests) & Thames frozen over

Medieval warm period: warming (900-1300), harvest records show lots of English grapes so warmer
Little ice age: 17th cent London frost fairs show Thames frozen over

Climate change: human activity:

Enhanced greenhouse effect:
Sun emits short wave length radiation, some absorbed, some reflected back 2 space but fossil fuels create insulation layer= long-wave length radiation cannot escape so earth warms

CH_4 retains 21x as much heat as CO_2

Human activities:
Farming: cattle emit CH_4 & cattle ranching clears land = no carbon sinks, flooded rice paddies emit CH_4
Industry: industrial waste in landfill emits CH_4, cement (limestone) emits CO_2 (carbon reacts with oxygen in air)
Energy: power stations are powered by fossil fuels
Transport: NEEs = increased car travel = congestion = CO_2 e.g. in China

Evidence:
Arctic ice decrease by 3% each decade over past 35 years (shows ocean temp higher than -1.8 degrees cel)
Since 1880, 1 degrees cel global temp rise, top 10 warmest summers all since 2000
Since 1950s, more extreme weather, Dec 2015 = wettest month in UK ever
Since 1901, sea level rise by 0.2m: ice caps melt (H_2O returns to oceans), thermal expansion: icecaps expand with higher temps

Social impacts of climate change:
Low lying coastal areas flood as sea level rise (migration as property loss)
High latitude nations benefit from heat for larger crop yields
Low crop yields = starvation & death (near equator)
Extreme weather = more investment into prediction & prevention

IPCC: conduct climate change projections (based on: industrial growth, clean energy use ect)
Scenario 1 = greenhouse gases peak then fall
Scenario 2 & 3 = greenhouse gases rise then fall steadily
Scenario 4 = emissions increase

Emission uncertainty:
Factor in population increase & development
Natural processes so complex model
Management strategy success

Tropical cyclones:

Formation: 26.5 degrees cel water & low wind sheer, source area = 5-30 degrees N & S of equator (low pressure)

Low pressure storms = surface winds increase
Earth's rotation deflects wind path = cyclone spins
Path curves towards mid-lat westerlies
Energy source cut off on land

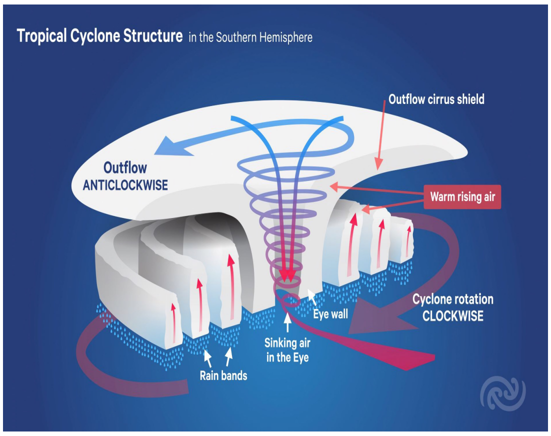
Dissipation: over land (as loose thermal energy source of water) & lower wind speed

Features:
7-14 days duration
Eye: low pressure, 50km width
Eyewall: 160 km/hr winds, torrential storms
Edges of cyclone: wind speed falls, temp decreases & rainfall reduces

Cyclones spin: anti-clockwise in northern hem, clockwise in southern hem

Impacts:

High winds: <250km/hr
Rainfall: intense near Eye
Storm surges: rise in sea level (high winds & rainfall)
Coastal flooding: as storm surges & winds
Landslides: rain makes hills unstable



Social impacts:
Drowning
Infrastructure damage: power cuts & sewage (contamination of H20 supplies = disease)
Homes destroyed = homelessness
Injuries, aid cannot reach remote areas as road damage
Unemployment = lower GDP

Environmental impacts:
Trees uprooted = habitats destroyed
Erosion of habitat, freshwater pollution= disrupts ecosystem & food webs
Damage to coastal industrial buildings = chemicals pollute ocean

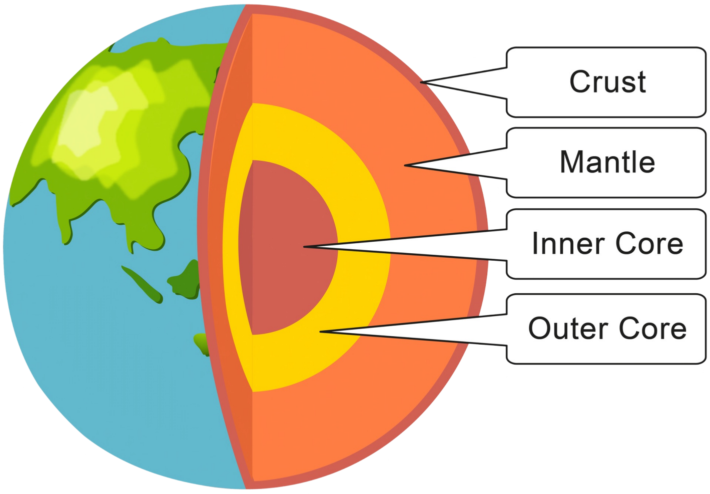
Vulnerability to cyclones:

Physical: low-lying coastlines flooded due to storm surges, areas in path of cyclones = hit
Economic: MEDC have expensive infrastructure damage costs, LEDCs = no insurance & crop damage = loss of livelihoods
Social: LEDCs: bad healthcare, infrastructure collapses = casualties & no £££ for prep

Cyclone response:

Forecasting: Weather & satellite tech predict path of cyclone (magnitude via windspeeds: saffir-Simpson scale) 4 evacuations
Evacuations: warning tech & evacuation routes planned to reduce casualties, training emergency services increases response times
Defences: Sea walls mitigate storm surge damage, buildings on stilts (less flooding.)

Earth's structure:



Core:
Inner = solid
Outer = liquid
Less dense outwards
4500-6000 degrees cel

Mantel:
Silicon-based rocks
Asthenosphere above mantel is semi-molten
1000-3700 degrees cel (cooler near crust)

Crust:
Silicon-based rocks
Oceanic crust: thinner, denser & younger than Continental crust
Divided into slabs = tectonic plates

Convection currents:
Radioactive decay in core = heat
Lower asthenosphere heats & rises, then cools & sinks as more dense in cycles
Drag is created on base of plates so they move

Plate boundaries:

Convergent (destructive): 2 plates move TOWARDS each other
Dense oceanic plates subducts under continental & is destroyed (volcanoes & ocean trenches form)
2 continental plates = ground folds = mountain ranges

Divergent (constructive): 2 plates move AWAY from each other
Magma rises = new crust formed e.g. Mid Atlantic ridge

Conservative: 2 plates slide PAST each other @ different speeds
E.g. along west coast of USA

Volcanic hazards:

Convergent plates: oceanic plate subducts & is destroyed, magma rises through vents & lava erupts = volcano

Divergent plates: magma rises in gap as plates move apart = volcano

Hotspots: magma from mantel moves to surface = flow of heat to crust = eruption
Remain stationary but crust moves = chains of volcanic island e.g. Hawaii

Volcano types:

Composite:
convergent pbs
Gases (subducted oceanic plates has H2O so reacts with magma) = explosive
Andesitic lava with high silica content = viscous so steep sided cone

Shield:
Divergent pbs
Only lava so not explosive
Erupt basaltic lava (low silica content = low viscosity) = spread so gentle slope

Earthquake hazards:

Convergent: tension as plates get stuck
Divergent: tension in cracks as plates diverge
Conservative: tension as friction between plates sliding past each other

Plates jerk past each other = seismic waves (vibrations)
Moment magnitude scale measures energy released by earthquakes

Focus: where earthquake starts in earth
Shallow-focus: near surface (0-70km below)
Deep-focus: previously subducted plates (decomposing or heating up), 70-700km below Earth's surface; less damage as seismic waves travel through layers of rocks so less intense at crust

Tsunamis: water displaced = big waves as seabed moves
Waves spread from epicentre (above the focus), shallow-focus displace more H20 (being closer to the surface)

Managing tectonic hazards:

Earthquakes:
Lasers detect movement
Seismometers measure seismic waves
Radon gas measured
Rock expansion as increased pressure

Volcanoes:
Bulges in volcano (magma build up)
Thermal imaging cameras detect temp increase prior to eruption
Sulphurous gas emission

Long term planning:

MEDCs:
Training emergency services
Reinforce buildings with concrete
Educate on evacuation procedures
Stockpile supplies

Short term relief:
Shelter evacuated people
Treat casualties so less death
Provide temporary gas & electric
Recover dead bodies so no disease spread