WHY DOES IT ALWAYS RAIN ON ME?

AND WHO SHOULD I BLAME?

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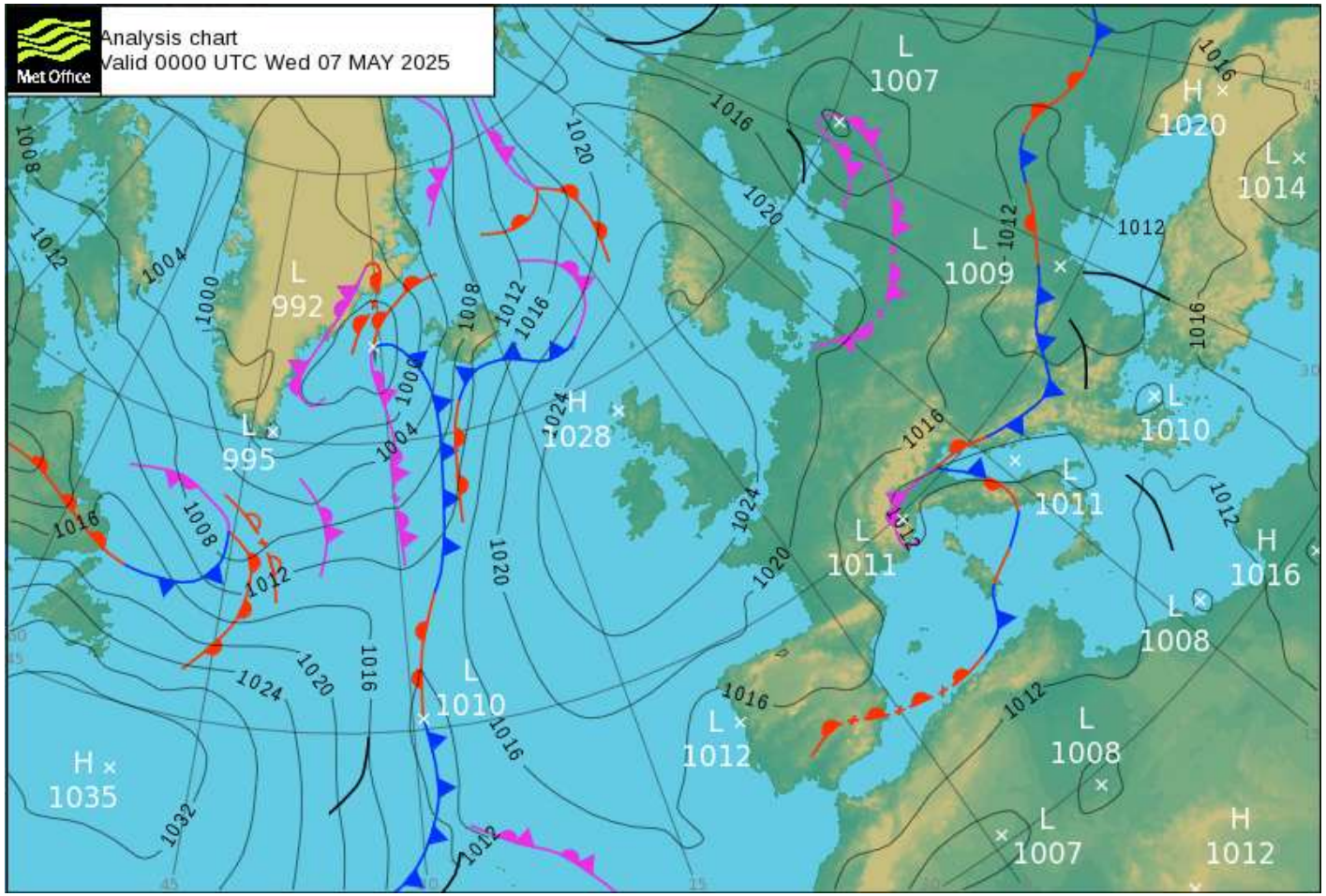
May 2025

What constitutes the weather?

- Air temperature
- Solar radiation (i.e. sunshine)
- Wind speed and direction
- Precipitation
- Humidity
- Air pressure

All change from day to day

Weather map


Met Office
Analysis chart
Valid 0000 UTC Wed 07 MAY 2025
L 1007
H 1020
L 1014
L 1009
L 992
H 1028
L 995
L 1010
L 1011
L 1011
H 1016
L 1008
L 1010
L 1012
L 1008
H 1035
L 1007
H 1012

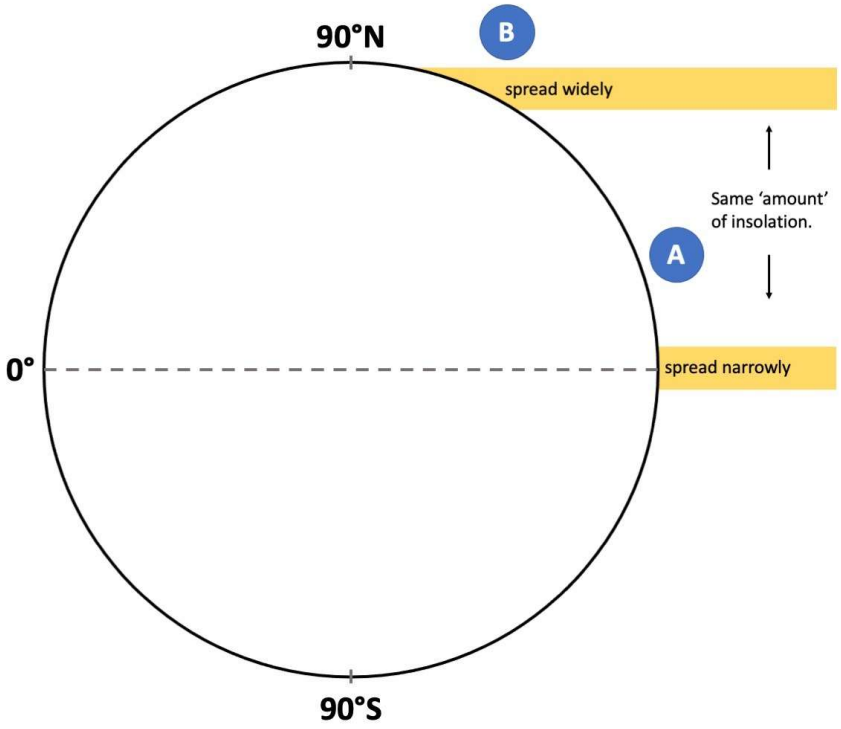
Why do these qualities constantly change?

- 3rd law of thermodynamics says differences in pressure, temperature etc. should equilibrate.
- Applies to a closed system with no external influences
- So what is the external force responsible for the earth's weather?

Solar Radiation

- Total radiation at top of atmosphere surface 1361w/m^2
- Radiation on ground surface normal to the sun 1120 w/ m^2
- Surfaces angled away from the sun receive less
- Part of the thermal radiation received at the surface heats the air above the surface.
- Amount of heat absorbed or released to air varies depending on surface i.e. soil, rock or water.
- So the pattern of atmospheric heating is very variable and constantly changing

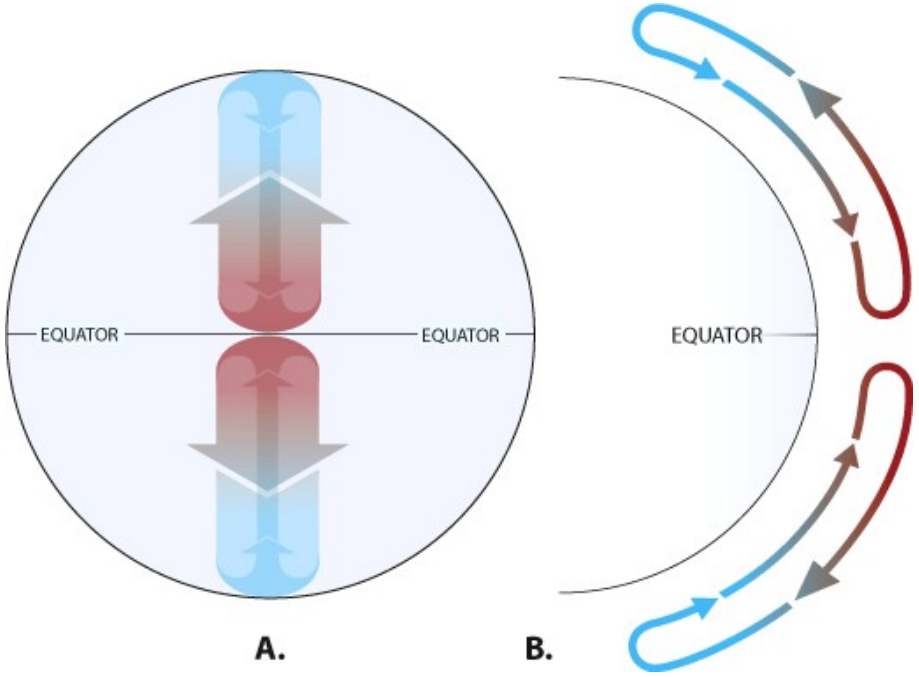
Insolation rates at different latitudes



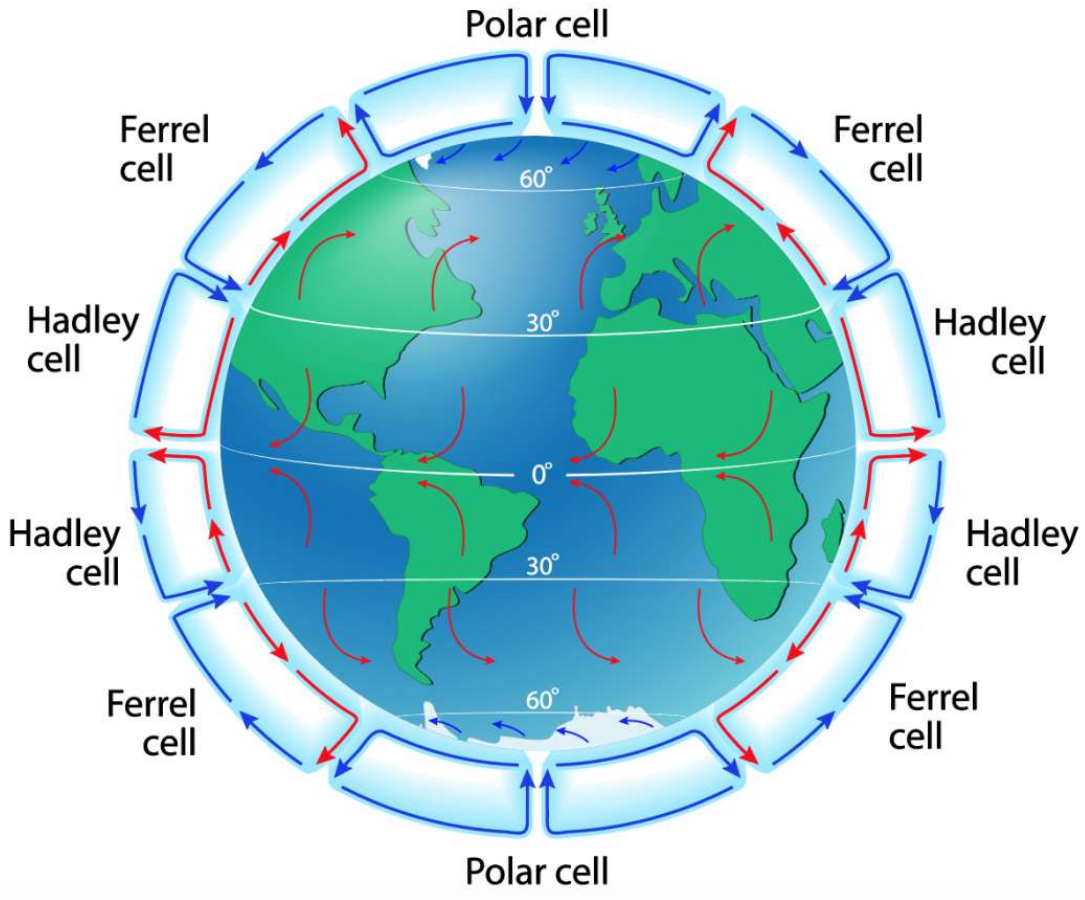
What causes wind?

- Wind is a result of air flowing from zones of high pressure to zones of low pressure
- Areas of low pressure created by convection currents formed when low density air is displaced vertically by surrounding high density air
- Air density depends on temperature and humidity
- Air above land areas that receive high insolation is strongly heated generating convection currents
- Convection currents generate circulation cells in the atmosphere

Convection Flows on Non Rotating Earth



GLOBAL ATMOSPHERIC CIRCULATION



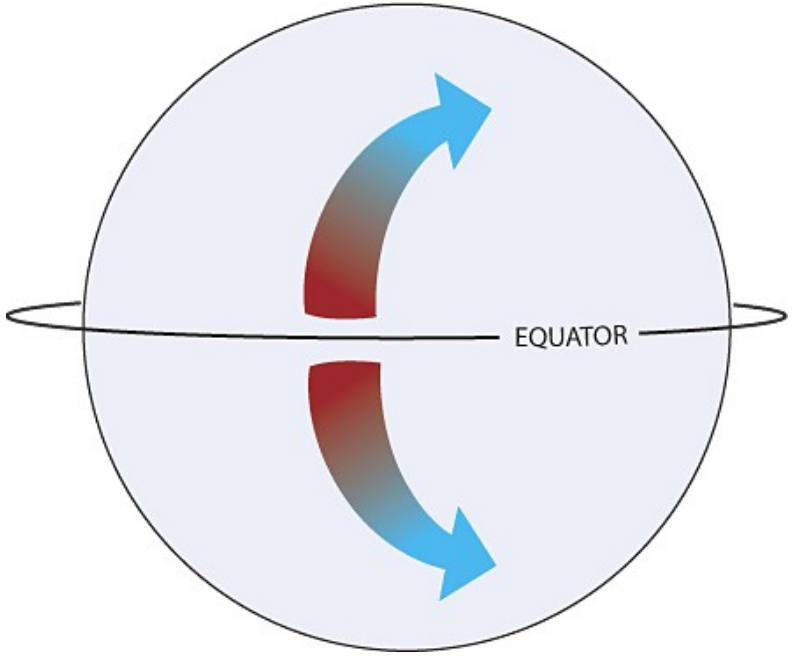
Complication 1 - The rate of air heating varies from place to place and time to time

- Through the daily cycle the amount of insolation the surface receives waxes and wains hence heating varies
- As night falls surface cools until air flow patterns go into reverse
- Rate of surface temperature change varies according to surface e.g. rock, vegetation, water

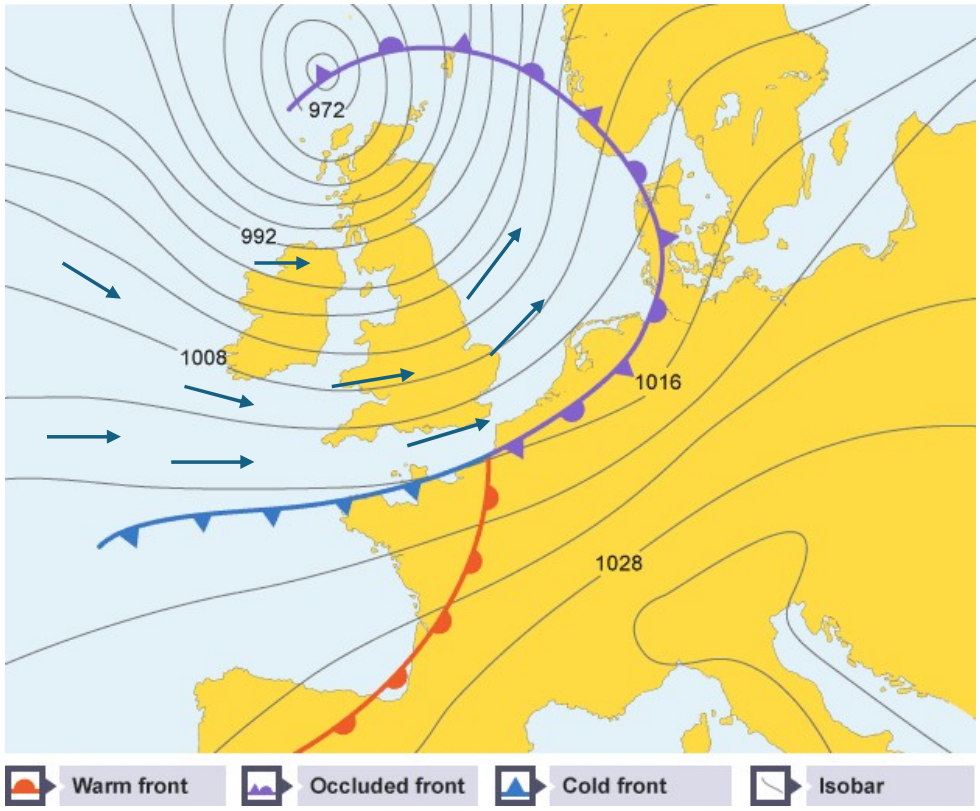
Complication 2 - The Earth spins hence the Coriolis Effect

- Tangential velocity at equator – approx. 1000 mph
- Tangential velocity at 30^{o} North - 866 mph
- Tangential velocity at 60^{o} North – 500 mph

Convection Flows on Rotating Earth



Wind direction vs Pressure Gradient



Coriolis Effect Impacts

- Vertical and Horizontal Components
- Affects both air flows (Wind) and water flows (Oceanic Currents)

Atmospheric Water Uptake

- Insolation effects
  - Heats air (sensible heat gain)
  - Evaporates water (latent heat gain)
- Latent heat of evaporation of water 2458 kJ/kg
- At midday on the equator insolation can evaporate 0.455 gm/s /m^2 of water
- Proportion of sensible vs latent heat gain dependent on nature of surface

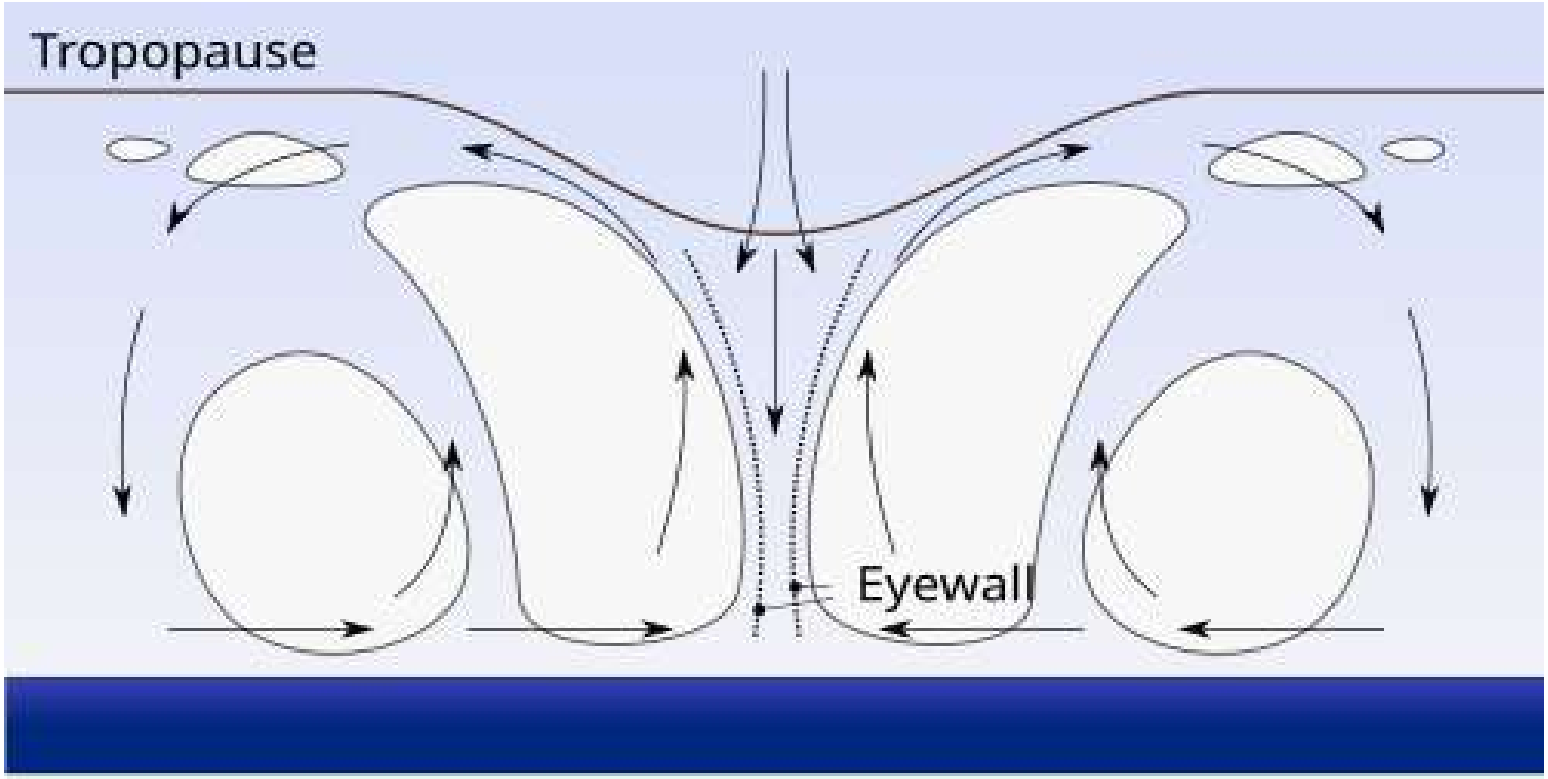
Impact of Surface

Arid land	Mainly sensible heat rise giving strong convective effects and low humidity
Vegetated Land	Mixture of sensible and latent heat gain giving variable convective effects and variable humidity
Sea	Mainly latent heat gain. Air remains cool suppressing convective effects but gains high humidity

Impact of Humidity

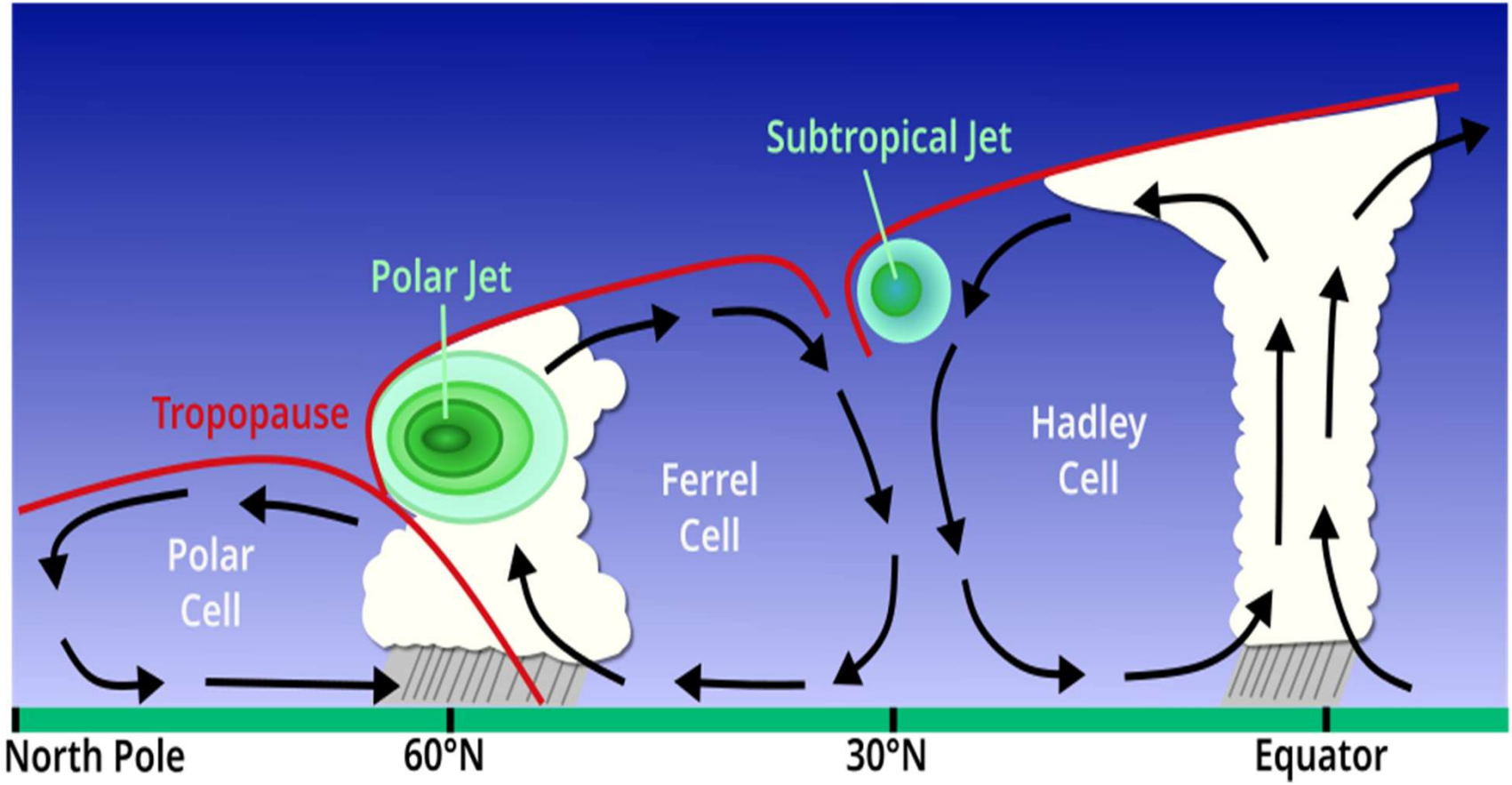
- Warm air increased capacity for water vapour
- Humid air less dense than dry air hence upward convective flow
- Rising air cools leading to water condensing out
- Condensation releases heat into air sustaining convective flow and generating low pressure air masses over the sea

Cyclone intensification



The Jet Stream

Jet Stream Formation at Cell Boundaries



Hence Weather

- Typically oceanic low pressure zones comprising warm moist air dragged eastwards by polar jet stream
- Run into cold air flowing southwards from the polar cell circulation
- warm moist air being less dense than the cold air flowing southward rides up over the dense air cooling as it rises until precipitation occurs