

## Geography Class 32

### A BRIEF REVIEW OF PREVIOUS CLASS (01:10 PM)

- Surface ocean current
- Different ocean currents of the world
- Significance of ocean currents

### UPWELLING AND DOWNWELLING (01:20 PM)

- **Upwelling**
- The offshore winds push the surface waters away and cause cold water from the bottom to rise up to the surface.
- Upwelling is more active in the regions of cold ocean currents.
- **Downwelling**
- The onshore winds pile up the water near to coast causing the sinking of water below the surface region.
- Downwelling is more active in the regions where warm and cold ocean currents meet.
- Near Polar regions, ice formation leaves the water saltier and denser causing it to sink.

Due to accumulation of water under the surface water moves under the surface also which is known as deep ocean currents or Thermohaline Circulations.

90 percent are surface current and rest are under water current.

Thermo means Temperature.  
Haline means Salinity.



## THERMOHALINE CIRCULATIONS (01:32 AM)

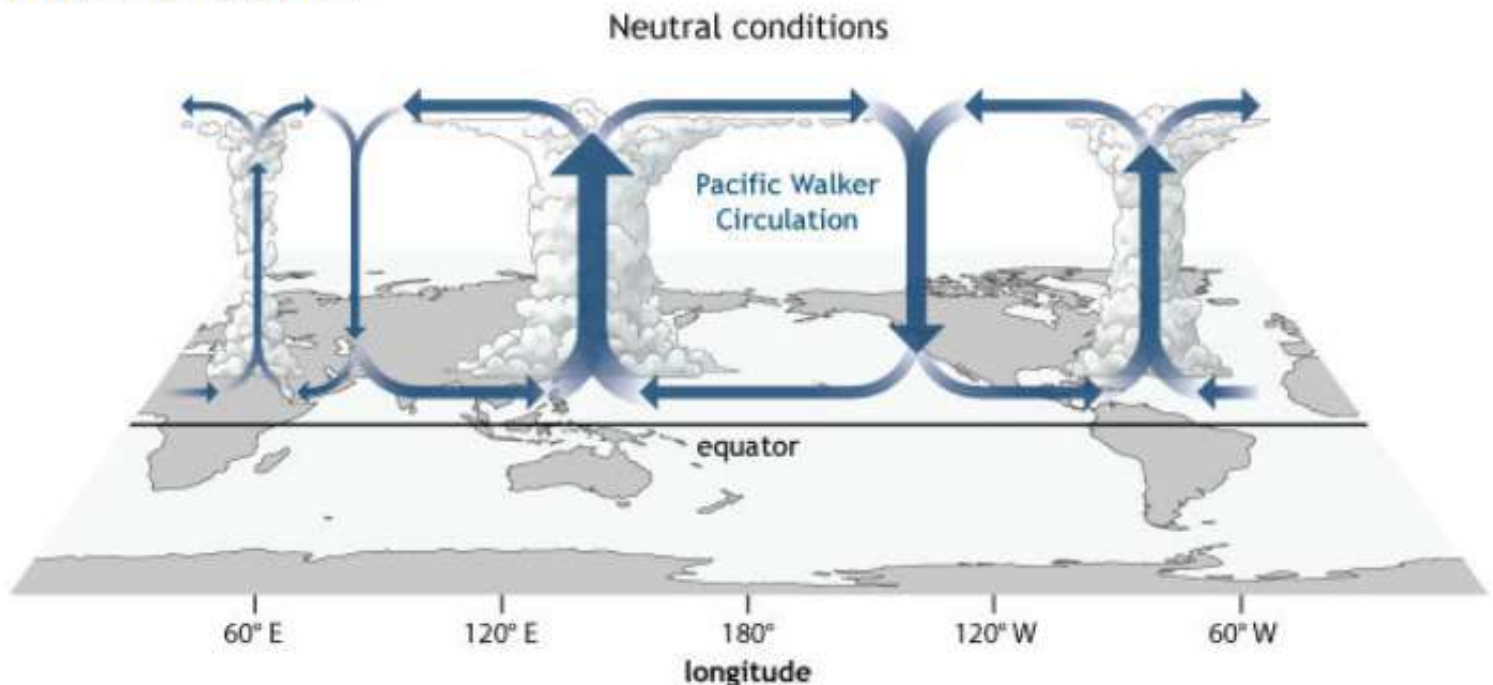
- The deep ocean currents are driven by differences in water density which is controlled by temperature and salinity and is called as Thermohaline circulation.
- The circulation begins near Polar regions of downwelling where ice formation leaves the water saltier and denser leading to sinking.
- This underwater current moves in a single and continuous belt across the different oceans.
- They are also connected to surface water currents in the regions of upwellings.
- They are called as the **Great Ocean conveyor belts**. Due to Global Warming temp. difference decreases which is decreasing AMOC.
- **Atlantic meridional overturning circulation (AMOC)**
- AMOC is part of the thermohaline circulation in the Atlantic Ocean.
- The recent <sup>AR6</sup> report of the IPCC predicts the weakening of AMOC due to global warming. There is a chain of cold and warm ocean current in which warm surface ocean current moves from equatorial to polar regions and cold deep ocean currents move from polar to equatorial regions.
- **Factors responsible for weakening.**
- Decrease in temperature between tropical and polar regions due to Arctic amplification.
- Excessive addition of fresh water reduces downwelling. ( because fresh water is warm and will not go under surface )
- Weakening of North Atlantic Drift.
- **Impacts of Weakening**
- The western part of oceans in tropical regions experiences a rise in sea levels.
- Increased occurrence of cyclones in tropical waters.
- Disturbance of fishing zones.
- British climate experiences harsh winters and frozen ports.
- Disturbance of marine ecosystem due to variation in temperature and salinity.
- **E.g.** Coral bleaching.

## **WATER MASS (01:56 PM)**

- It is a body of water with uniform characteristics of temperature and Salinity.
- There are **three types of water masses**-
- i) Surface water mass. E.g. Sub-Tropical surface water mass ( i.e. in the region of Gyre because there will not too much movement of water.)
- ii) Intermediate water mass. E.g. Antarctic water mass
- iii) Deep water mass. E.g. North Atlantic deep water mass.
- **Significance of Water Mass**
- The movement of water mass helps in the distribution of temperature, salinity, and Oxygen.
- It helps in the generation of Thermohaline circulations.
- It results in the generation of upwelling and downwelling.
- Uniforming of conditions within water mass supports the growth of plankton and Coral Reefs.

## EL NINO AND RELATED CONCEPTS (02:12 PM)

- Walker circulation



- In the Pacific Ocean, the ITCZ usually remain near or above the equator.
- Near South American West Coast strong trade winds blow offshore and push surface water westward away from the continent.
- To replace this water, cold water upwells and the air above this cold water is stabilised and convection is suppressed.
- The water flows westward as South East trade winds blow towards the west Pacific region.
- This gets heated and raised through convection and flows eastward in the troposphere.
- This subsides along the eastern Pacific completing the cell.
- This causes high pressure and low temperature along the eastern Pacific Ocean, and low pressure and high temperature along the western Pacific Ocean.
- The resulting convective cell is called as **Walker circulation**.
- In normal conditions, the eastern Pacific coast experiences draught and the western Pacific receives good rainfall.



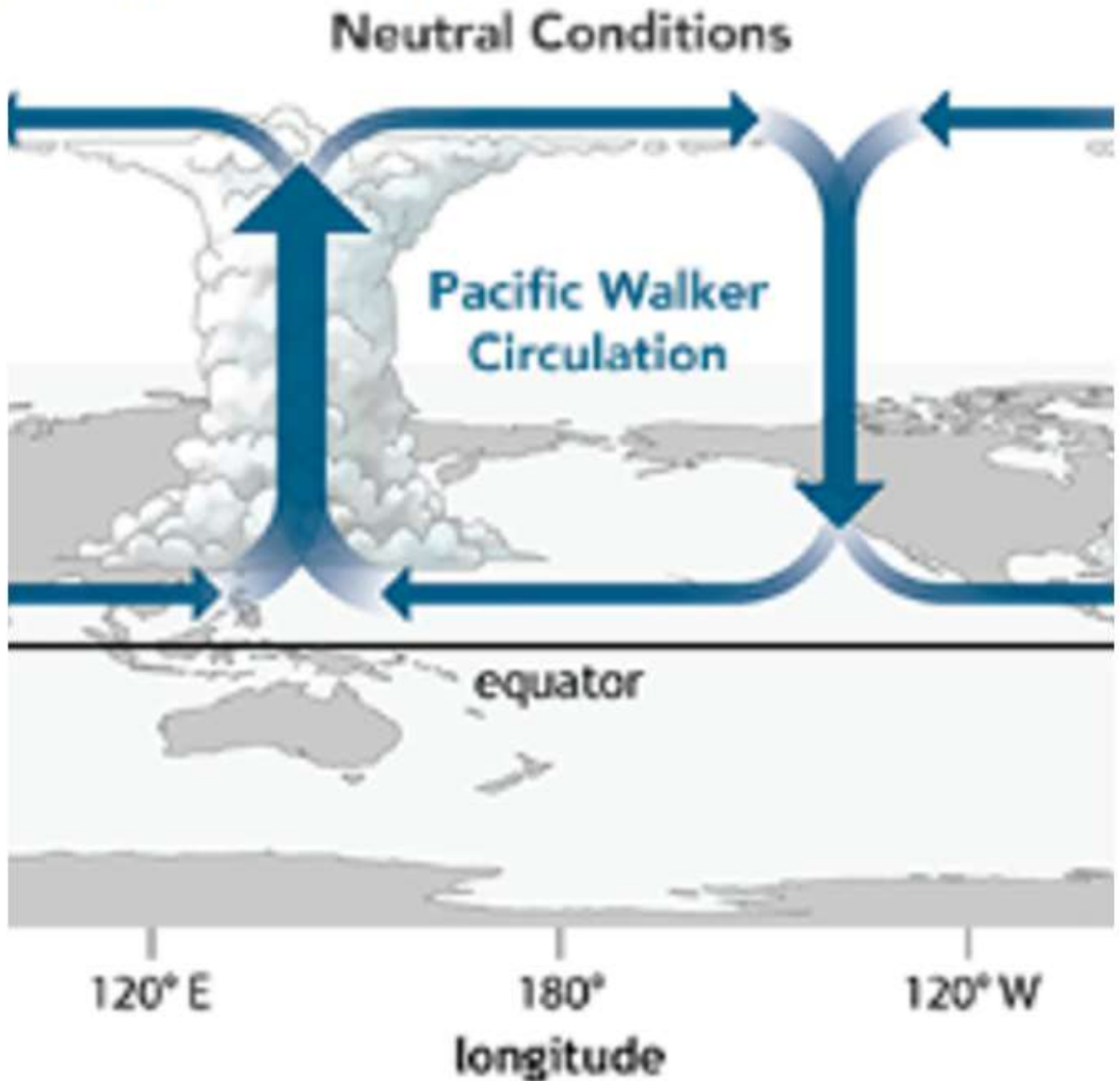
that is why Atcama desert is the driest desert.



The literal meaning of El Niño in Spanish is "The Little Boy" or "The Christ Child".

In recent time we have seen ITCZ has been shifting to southward and because of this intensity of trade winds decreases and temperature of water near Peru coast starts to increase and because of this temperature increases and therefore convection and rainfall happens and water starts to move from Australian coast to Peru coast and normal circulation get reversed which is known as El-Nino Southern Oscillation because it is happening in southern part.

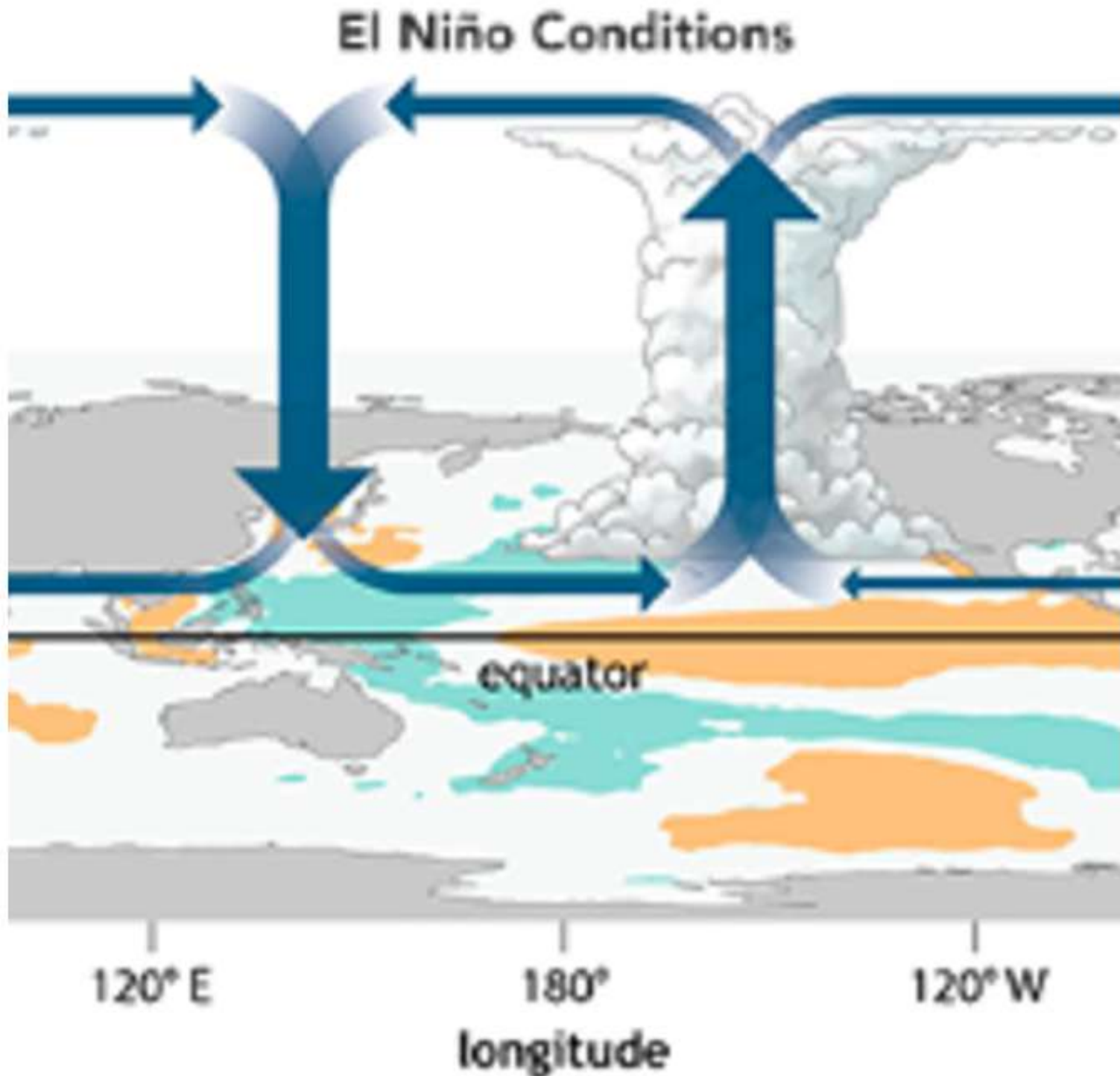
### EL NINO AND LA NINA (03:02 PM)



Due to El-Nino all cycle get reversed, the region of south-east China and parts of Indo-China heavily depends on agriculture and this get impacted because high pressure gets generated there and rainfall will not happen and the region of western coast of south America gets impacted because their economy mainly dependent on fishing and fertilizer and because of El-Nino nutrients will not come out from deep ocean therefore growth of Phytoplankton get hindered and therefore growth of fish and fertilizer. Bleaching of coral reefs also can be seen here.

El-Nino also impact S-W monsoon that comes to India because due to high pressure it also disturb this monsson.

Since ITCZ shifts to south of equator so convection of El-Nino combine with Hadley cell and circulation of Hadley Cell increases which again increases speed of trade winds and situation will get back to the normal condition.



La-Nina is the intensification of Walker Circulation of so because of this there will be high precipitation at Indo-China and near by region and it creates high pressure at western coast of South America which will cause total dry condition.

- It means Christ's child or little boy.
- Once in 2 to 7 years, in October and November, the ITCZ moves too much south to the equator resulting in a weakening of trade winds.
- This reduces the upwelling.
- The warm tropical surface waters earlier flowing towards the west flow back eastward and cause a further reduction in upwelling.
- This results in warm surface water off the coast of South and Central America called as El Nino.
- The appearance of El Nino causes air pressure to drop over the eastern Pacific coast and rise over the western Pacific coast.
- This sea surface variation of air pressure is called as **El Nino Southern Oscillation (ENSO)**.
- El Nino causes heavy precipitation along the eastern Pacific and drought conditions along the western Pacific.
- After 1 or 2 years enhanced Hadley circulation strengthens the trade winds.
- Stronger trade winds **increase** cold water upwellings and bring back normal conditions.
- **La Nina**
- It means little girl.
- El Nino is usually followed by La Nina.
- It is the intensification of high pressure and cold temperatures along the eastern Pacific and low pressure and high temperatures along the western Pacific.
- This causes very high precipitation in India and Australia and higher dry conditions in Peru and Chile.
- The strongest recorded El Nino years were 1982-83, 1979-98, 2014-16. Recent El Nino was witnessed in 2018-19, and La Nina in 2020-23.



- **SIGNIFICANCE OF EL NINO (03:42 PM)**
- Disturbance of walker circulation causes disturbance in global weather patterns and the convection cycles are also disturbed in other oceans.
- It causes drought and dry conditions in India and Australia and heavy precipitation along the coastal deserts of Peru and Chile.
- It may reduce the intensity of winds, timing of onset and withdrawal, and distribution pattern of Monsoonal rainfall.
- The dry conditions in India and Australia easily trigger forest fires or wildfires.
- It results in severe dust storms in India and Australia.
- The warm water inhibits the growth of plankton and Algae and suppresses upwelling devastating the marine ecosystem and killing fish along Peru and Chile Coast.
- The decomposition of fish releases toxic chemicals and Hydrogen Sulphide causing waters to become dark and foul-smelling.
- This results in a catastrophic impact on the fishing and fertiliser industry.
- El Nino years cause mass coral bleaching due to the disturbance of stable conditions and high temperature of ocean water.
- **Positive impact of El Nino**
- During El Nino years high pressure in the Caribbean sea, the western Pacific and the Bay of Bengal suppresses cyclone formation.
- Precipitation along the coast of Peru and Chile causes large-scale growth of small flowering plants in desert areas.

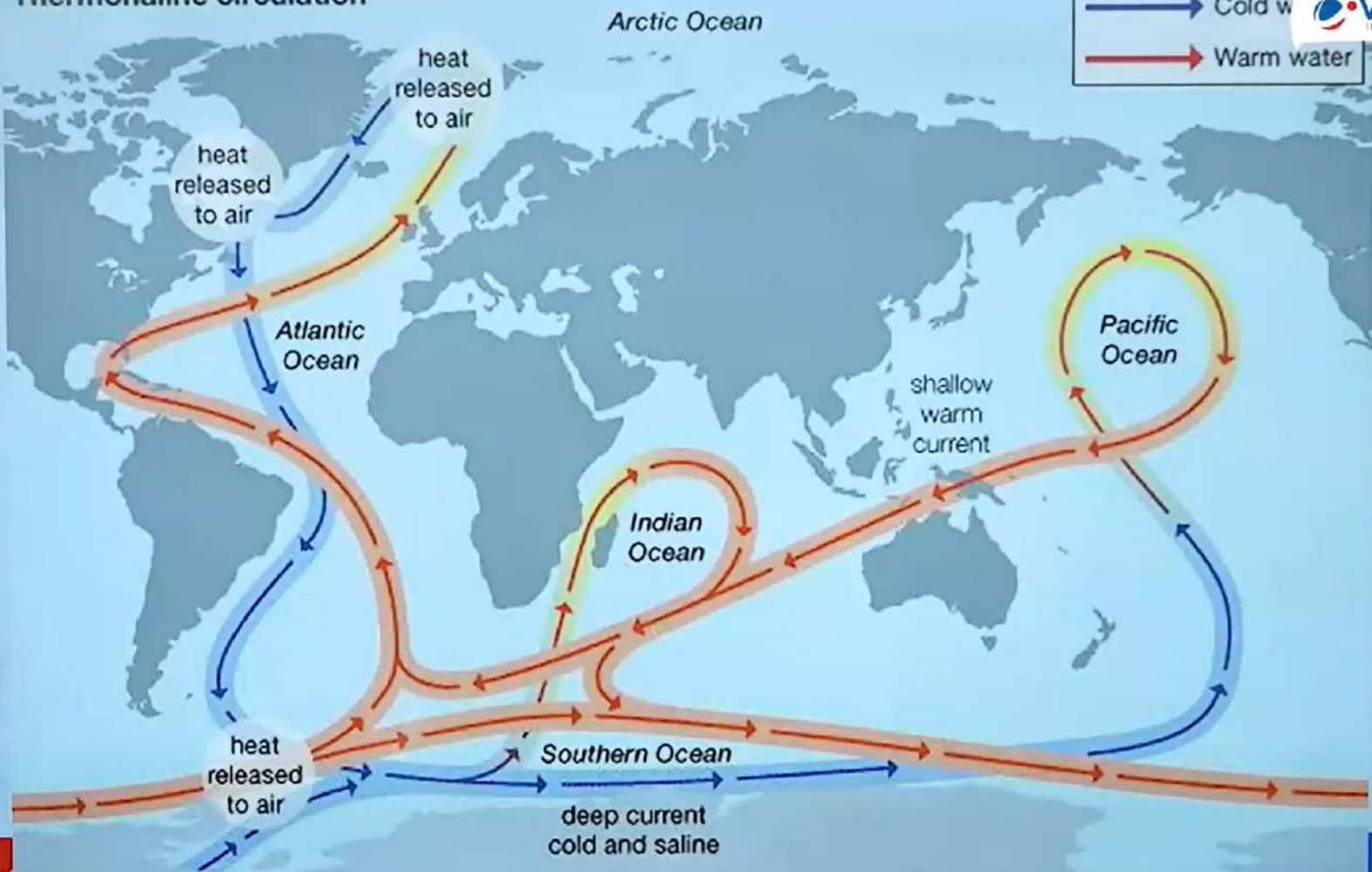


### **EL NINO MODOKI (04:01 PM)**

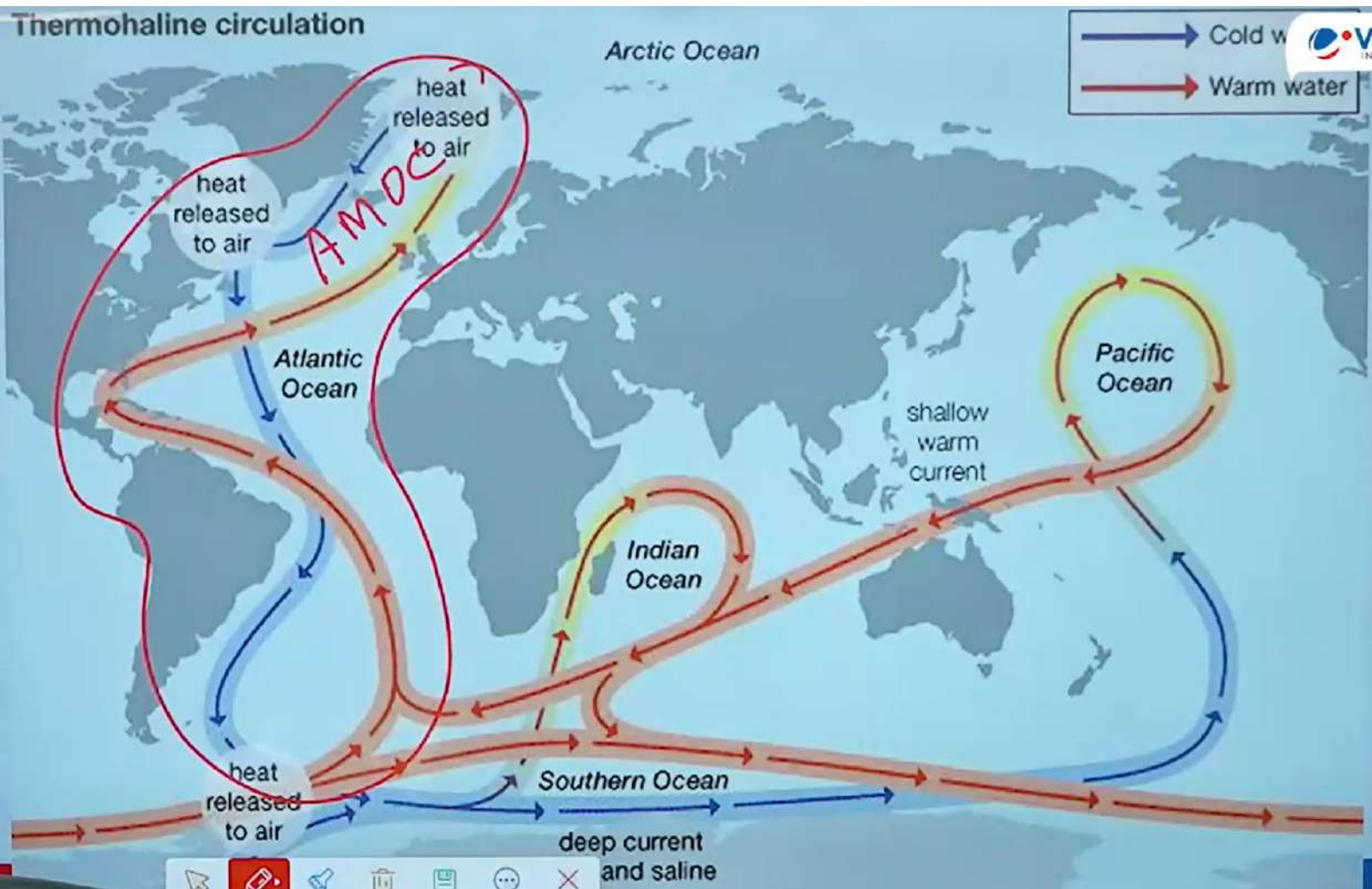
- While El Nino is characterised by strong warming in the eastern Pacific, El Nino Modoki results in the warming of the central Pacific with dry conditions along the eastern and western Pacific.
- It creates a two-cell walker circulation over the tropical Pacific region with precipitation at the central part and dry conditions along the eastern and western parts.
- While El Nino results in diminished hurricanes in the Caribbean Sea, El Nino Modoki causes increased occurrence.
- During this time, cyclones occur more in the Arabian Sea than in the Bay of Bengal.

**TOPIC OF THE NEXT CLASS- INDIAN OCEAN DIPOLE, HEAT DOME, TIDES**

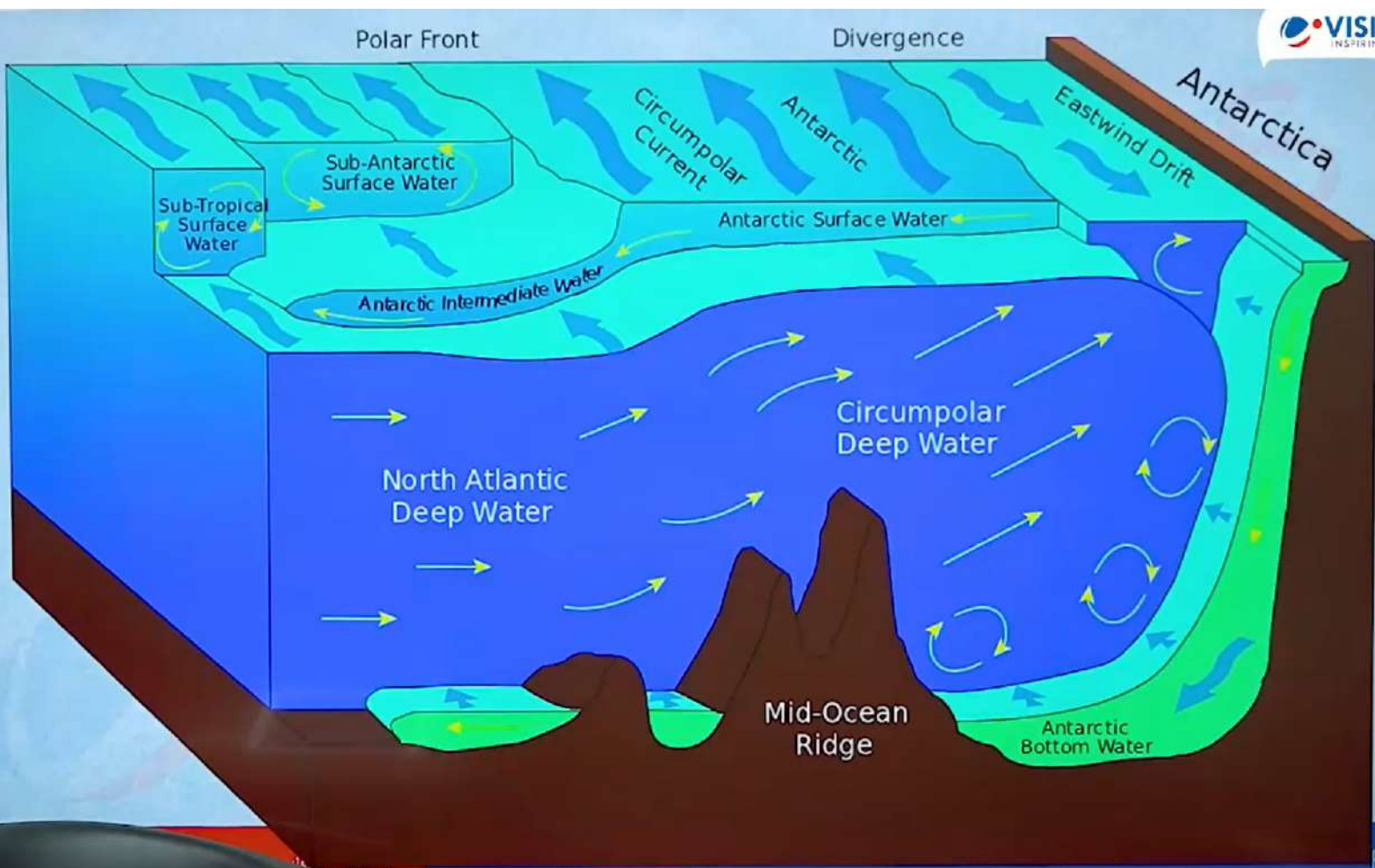
## Thermohaline circulation



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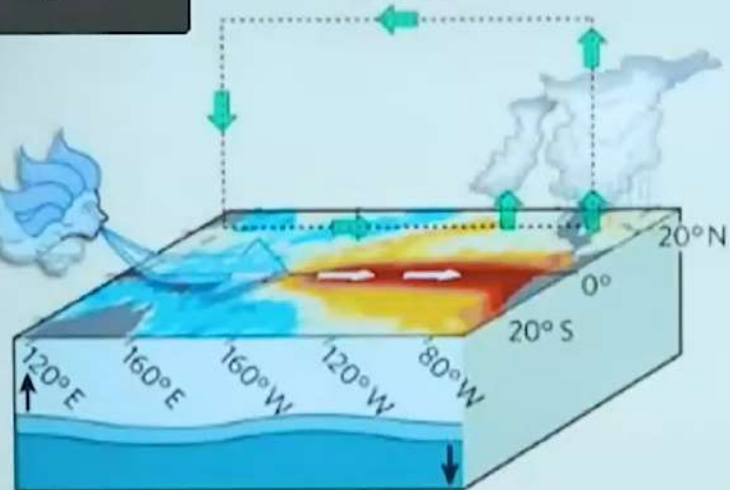






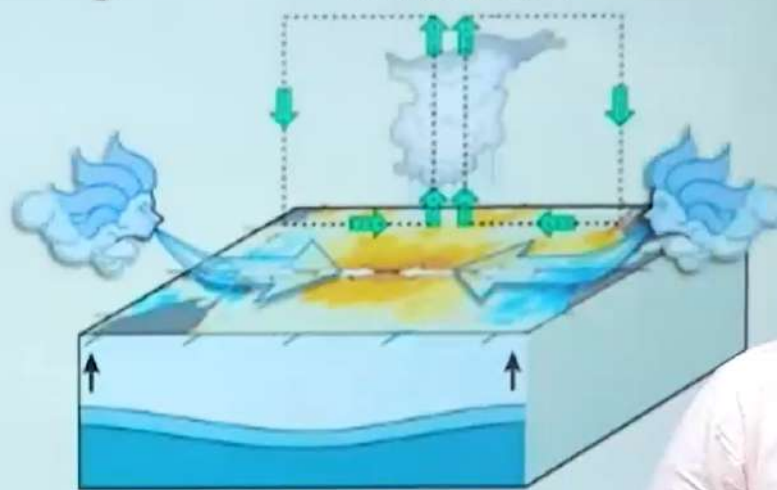
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El Niño

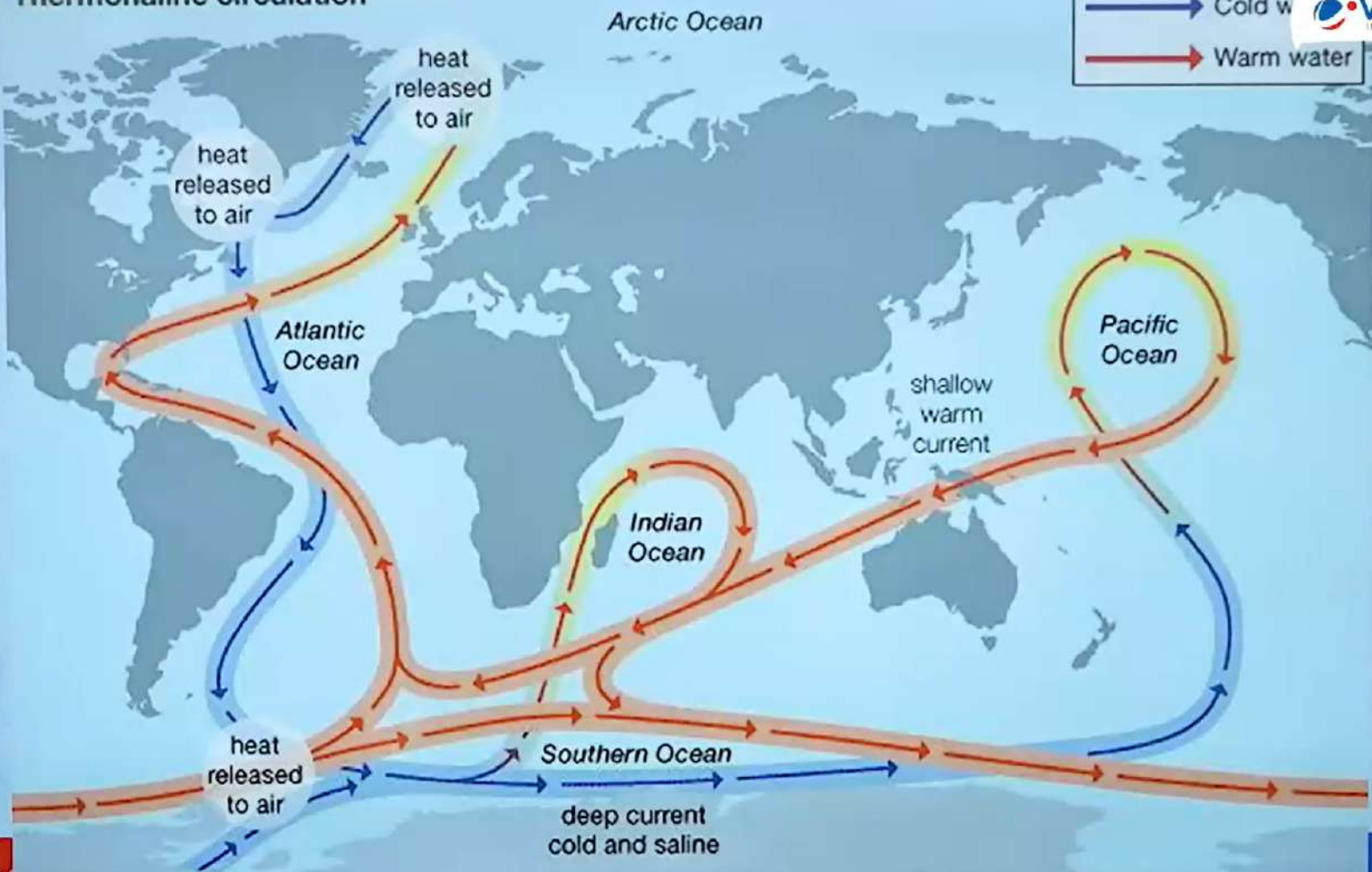


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El Niño Modoki

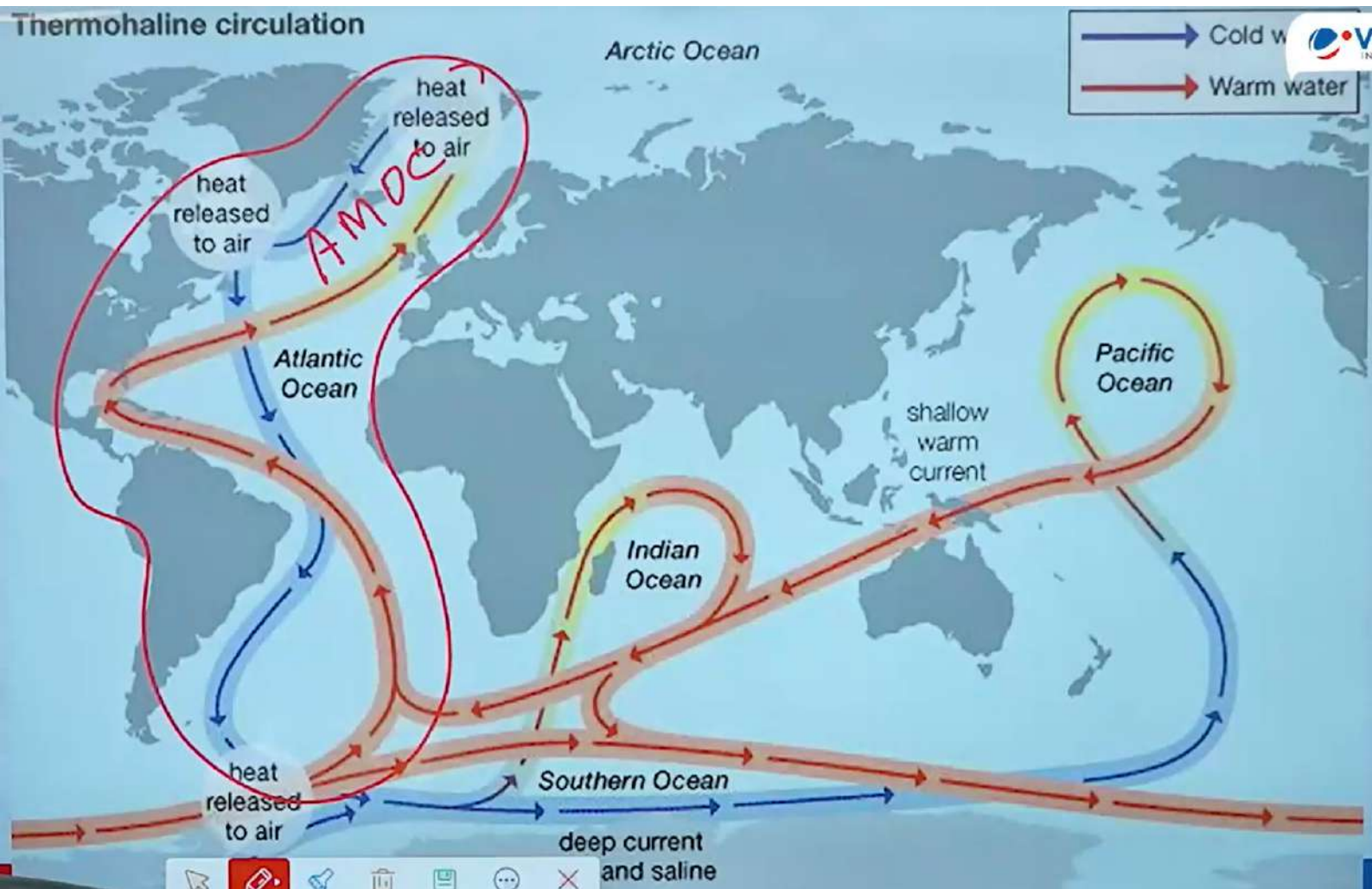


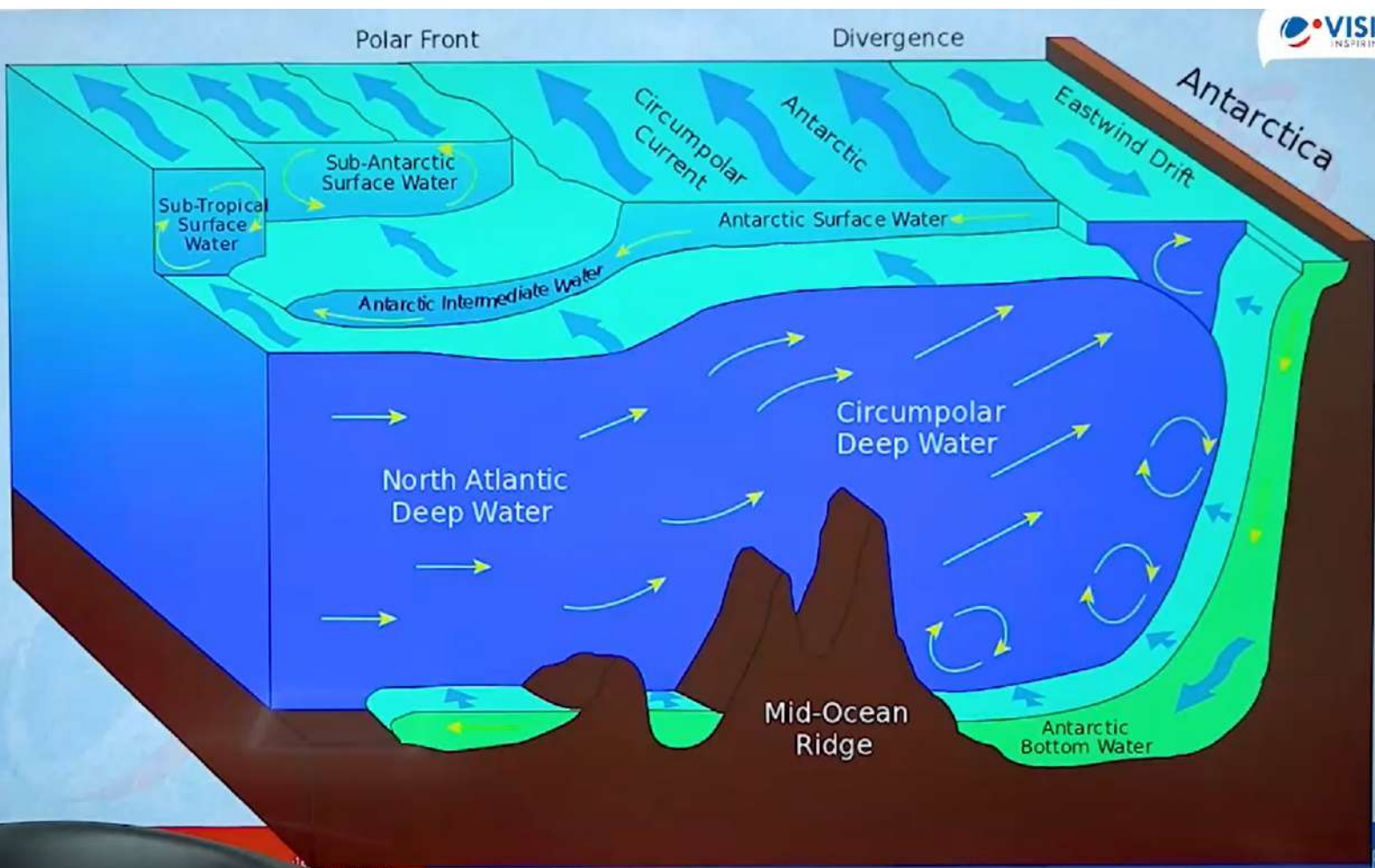
## Thermohaline circulation





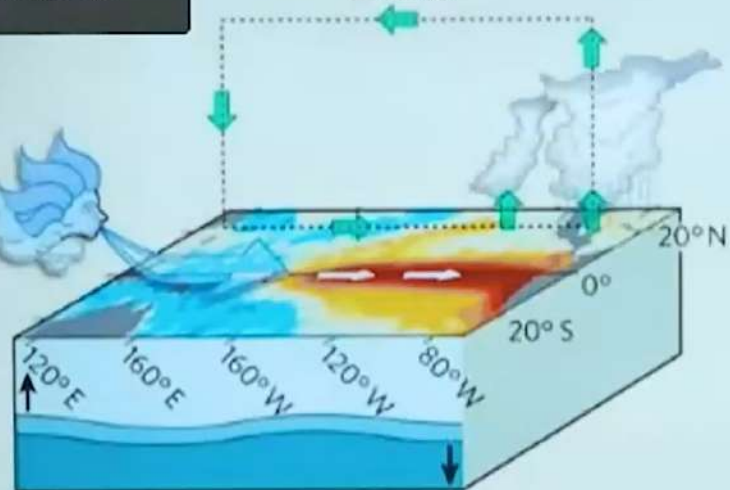
## Thermohaline circulation





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El Niño



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El Niño Modoki

