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Atlantic Ocean Current System: AMOC

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Why in News

According to the recently released **IPCC's Report**, **Atlantic Meridional Overturning Circulation (AMOC)** is **losing its stability** and is very likely to **decline over the 21st century**.

The ocean has an interconnected current, or circulation, system powered by wind, tides, the Earth's rotation (Coriolis effect), the sun (solar energy), and water density differences.

Key Points

- **About AMOC:**
 - It is a large system of ocean currents.
 - It is the **Atlantic branch of the ocean conveyor belt or ThermoHaline Circulation (THC)**, and distributes heat and nutrients throughout the world's ocean basins.
- **Working of AMOC:**
 - AMOC carries **warm surface waters from the tropics** towards the Northern Hemisphere, where it cools and sinks.
 - It then **returns to the tropics** and then to the **South Atlantic as a bottom current**. From there it is **distributed to all ocean basins** via the Antarctic Circumpolar Current.

The **ACC** is the **most important current in the Southern Ocean**, and the **only current** that flows **completely around the globe**.

- **Implications of decline of AMOC:**
 - **Without a proper AMOC and Gulf Stream**, Europe will be **very cold**.
Gulf Stream, a part of the AMOC, is a **warm current responsible for mild climate** at the Eastern coast of North America as well as Europe.
 - An **AMOC shutdown would cool the northern hemisphere and decrease rainfall over Europe**.
 - It can also have **an effect on the El Nino**.
El Nino is a **climate pattern** that describes the **unusual warming of surface waters** in the eastern tropical Pacific Ocean.
 - It can also **shift monsoons in South America and Africa**.
- **Causes:**
 - Climate models have long predicted that **global warming** can cause a **weakening of the major ocean systems of the world**.
 - **Freshwater inflow** from the melting of the Greenland ice sheet.
 - In July 2021, **researchers noted** that a **part of the Arctic's ice called "Last Ice Area" has also melted**.
 - The **freshwater from the melting ice** reduces the **salinity and density of the water**.
 - Now, the water is unable to sink as it used to and weakens the AMOC flow.
 - **Indian Ocean** may also be helping the slowing down of AMOC.
 - **Increasing precipitation** and river run-off.
- **Importance of AMOC:**

It plays a **critical role in redistributing heat** and **regulating weather patterns** around the world.
- **Concerns:**

The AMOC decline is **not just a fluctuation or a linear response** to **increasing temperatures** but likely means the **approaching of a critical threshold** beyond which the **circulation system could collapse**.

Ocean Currents

- **About:**

Ocean currents are **located at the ocean surface and in deep water below 300 meters**. They can **move water horizontally and vertically** and occur **on both local and global scales**.

- **Surface Currents:**

- Surface currents in the ocean are **driven by global wind systems that are fueled by energy from the sun**. Patterns of surface currents are determined by wind direction, Coriolis forces from the Earth's rotation, and the position of landforms that interact with the currents.
- Surface wind-driven currents **generate upwelling currents** in conjunction with landforms, creating deepwater currents.

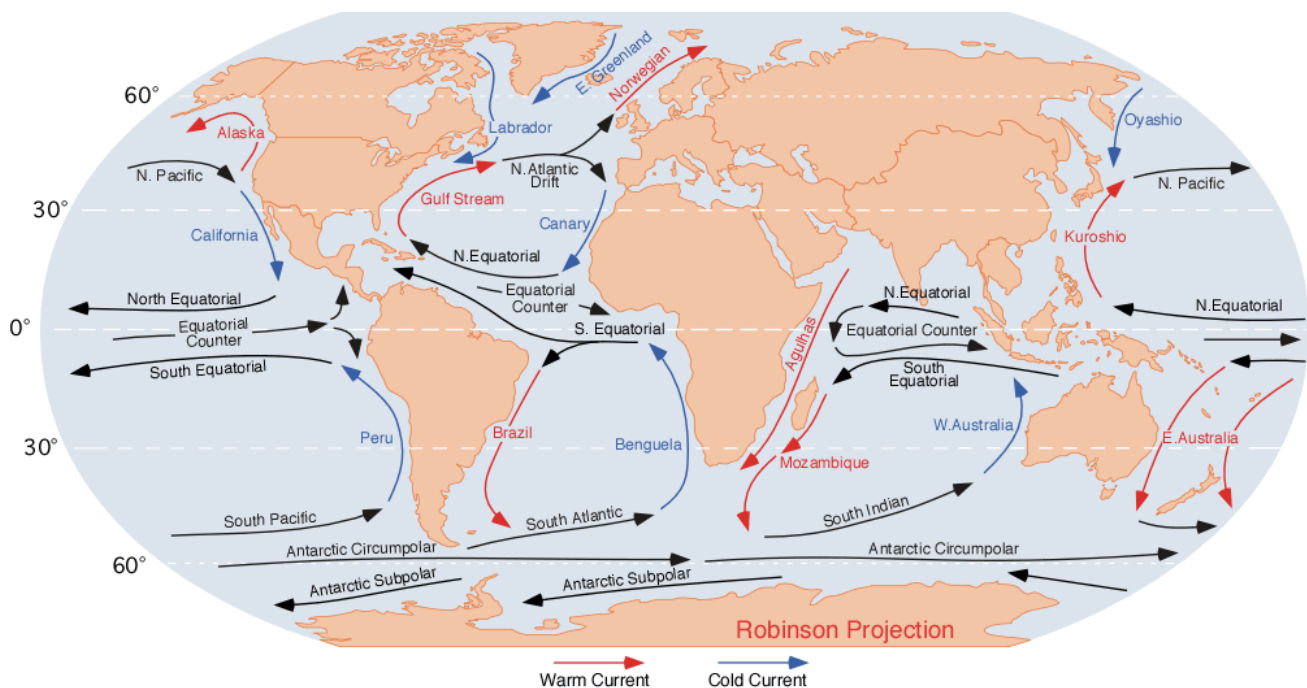
Upwelling is a process in which deep, cold water rises toward the surface.

- Along the east coast of the US, the **Gulf Stream carries warm water** from the equatorial region to the North Atlantic Ocean, keeping the southeast coast relatively warm.

Along the west coast of the US, the **California Current carries cold water** from the polar region southward, keeping the west coast relatively cooler than the east coast.

- **Gyre**, is a vast circular system made up of ocean currents that spirals about a central point.

Such as the Gulf Stream–North Atlantic–Norway Current in the Atlantic Ocean and the Kuroshio–North Pacific Current in the Pacific Ocean.

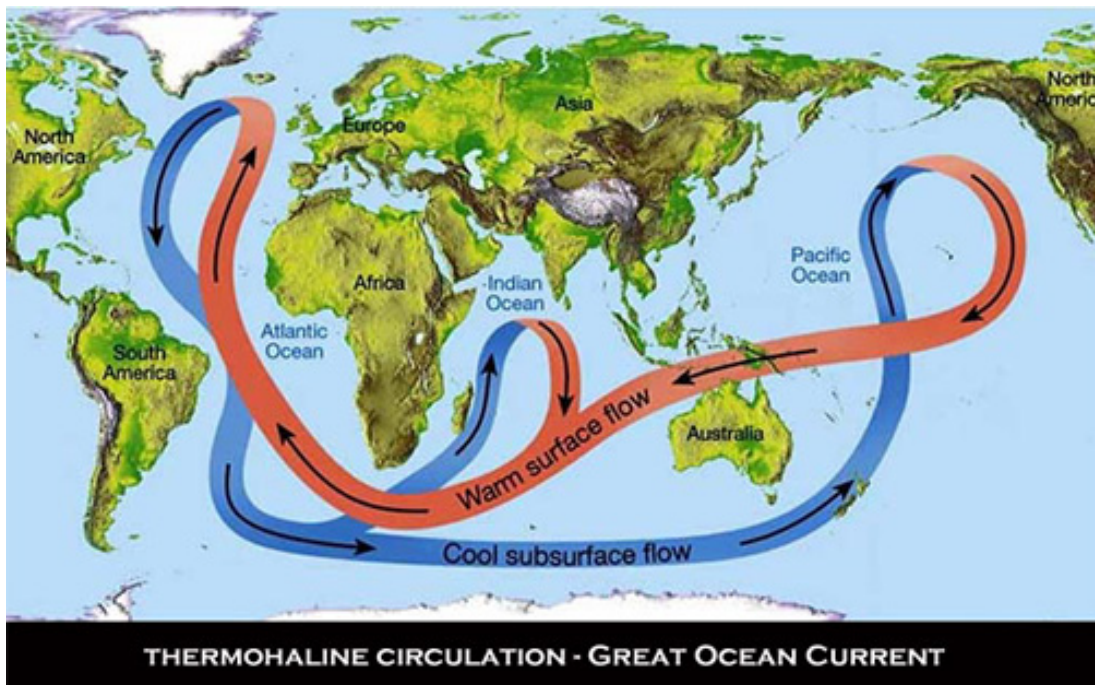


- **Deep Water Currents:**

- Currents may also be **caused by density differences in water masses due to temperature (thermo) and salinity (haline) variations via a process known as thermohaline circulation**.
- These currents **move water masses through the deep ocean**—taking nutrients, oxygen, and heat with them.

- **Conveyor Belt:**

- **Density differences in ocean water** contribute to a **global-scale circulation system**, also called the **global conveyor belt**. It includes **both surface and deep ocean currents** that circulate the globe in a 1,000-year cycle.
- The global conveyor belt's circulation is the **result of two simultaneous processes**: warm surface currents carrying less dense water away from the Equator toward the poles, and cold deep ocean currents carrying denser water away from the poles toward the Equator.
- The ocean's global circulation system plays a **key role in distributing heat energy**, regulating weather and climate, and cycling vital nutrients and gases.



Source: IE