Southern Ocean

Why in news?

Recently, a study on Southern ocean "Closing the loops on Southern Ocean dynamics: From the circumpolar current to ice shelves and from bottom mixing to surface waves " revealed more details on the dynamic nature of Southern Ocean.

What are the characteristics of Southern Ocean?

- It is also known as the Antarctic Ocean, comprises the southernmost waters of the world ocean.
- It used to be part of the Pacific Ocean and it is separated from other Oceans by currents, not Continents.
- **Location** – It is generally taken to be south of 60° S latitude and encircling Antarctica.
- **Size** - It is the second-smallest of the five oceans.

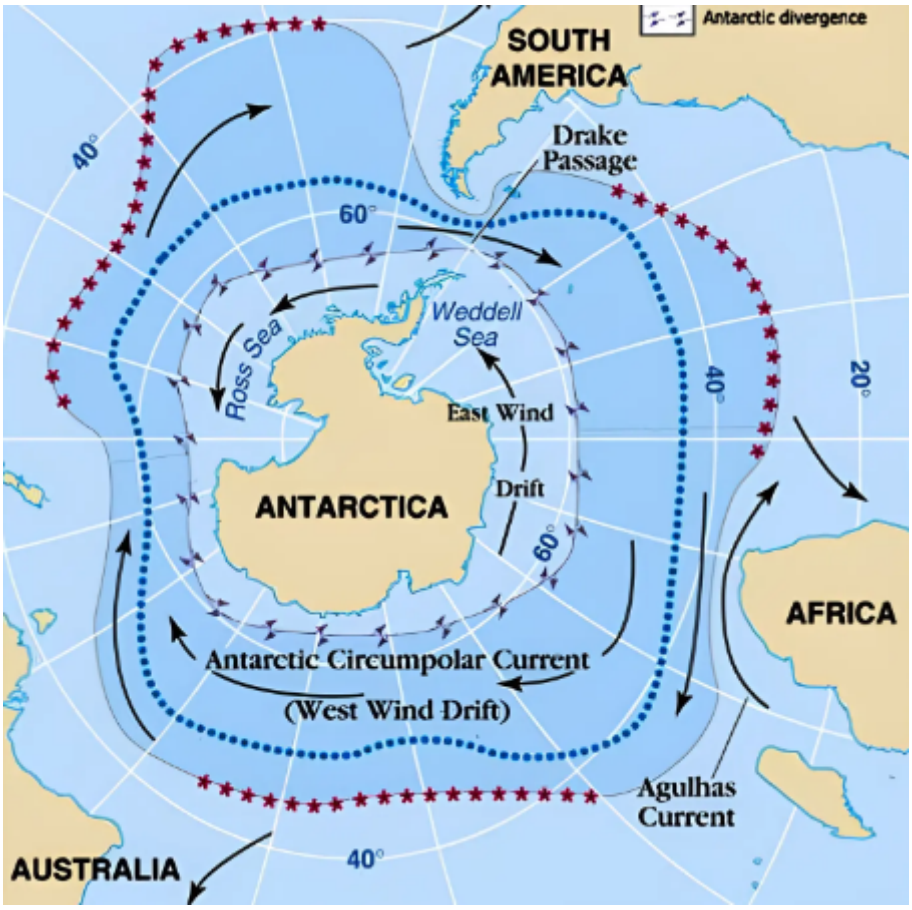


- **Characteristics** – It experiences *Earth's strongest winds and largest waves*.
- It is home to *city-sized icebergs*.
    - Antarctic Ice Sheet is the largest ice mass on Earth, equivalent to 58 metres of the global sea level.
    - The ice sheet flows onto the Southern Ocean surface in the form of giant ice shelves.
- It acts as an *ocean hub* as waters from the Atlantic, Pacific and Indian basins converge

and mix in Southern ocean.

- It experiences *dramatic seasonal changes* and cold temperatures.
    - During winter, Southern Ocean freezes into a fringe of sea ice, almost doubling the size of Antarctica.
- It encompasses the *biggest ocean current* on the globe, as well as tiny turbulent flows that fit inside a teacup.
    - Antarctic Circumpolar Current (ACC)
    - Antarctic Slope Current
    - Sub-polar gyres
    - The meridional overturning circulation.

Antarctic Circumpolar Current (ACC) is the longest, strongest, deepest-reaching current on earth and circulates clockwise around the continent, carrying more water around the globe than any other current.



Why Southern Ocean is called as a global engine room?

- It is crucial to Earth's natural systems.
- **Creates masses of Ice** - Much of the sea ice is produced in small regions of open water, called "polynyas", formed by strong and cold winds blowing off Antarctica.
- **Contributes to Ocean volume** - As the ice forms, it *ejects salt into the ocean surface* and this extra salt, in addition to cooling effects from the atmosphere, *makes the surface seawater heavier*/ dense.
- The dense water sinks into the deep ocean.

    - The resulting dense water mass produced here accounts for ***40% of the global ocean volume***.
- It is ultimately *lifted back to the ocean surface* by centimeter-scale turbulent eddies.

Sothern Ocean acts as a time capsule *as it takes hundred year for the ocean water from the surface to sink and return to surface. Water returning to the surface today reflects the cooler, pre-industrial climate when it first sank to the ocean depths.*

- **Forms Ice shelves** – Antarctic ice sheets flows onto the Southern Ocean surface in the form of giant ice shelves.
- **Solar reflector** - Millions of square kilometers of a layer of sea ice acts as a giant solar reflector.

Forms of Ice
• Ice sheet – It is also known as a continental glacier, is a mass of glacial ice that covers surrounding terrain and is greater than 50,000 km^2. • The only current ice sheets are the Antarctic ice sheet and the Greenland ice sheet. • Ice sheets- They are bigger than ice shelves or alpine glaciers • Ice shelf – It is a large platform of glacial ice floating on the ocean.

- **Heat sink** – It stores excess heat generated due to global warming.
- **Carbon Sink** – Excess carbon generated by anthropogenic greenhouse gas emission activities are absorbed by them.
- **Regulates sea level** – It controls the flux of heat to the huge ice sheet of Antarctica, the greatest threat to runaway global sea-level rise.
- It shields ice shelves from powerful Southern Ocean waves.
- **Productive ecosystem** - Powerful currents, cold temperatures and nutrient and oxygen-rich waters make the Southern Ocean one of the most productive marine ecosystems on Earth.
- In summer billions of microscopic algae (phytoplankton) proliferate, spreading into blooms large enough to be seen from space.

2021-2030 is adopted as UN Decade of Ocean Science for Sustainable Development.

- **Recent Challenges -** Southern Ocean's sea ice has dramatically declined in recent years due to global warming.
- Lowest ever recorded sea ice minima in the past two Austral summers.
- Warmer, less salty and more buoyant water is less prone to sinking.
- Thus affecting the ocean current system.

What lies ahead?

- Advance Southern Ocean science by bringing in the scientific and broader community

together to protect this vital natural asset.

- Promote technological innovation to develop more cost-effective observing systems such as drones and drifting robotic instruments.
- Governments need to make long-term commitments to scientific study of Antarctica and the Southern Ocean.
- Enhance national and international collaboration to make the best use of available resources.
- Take a multidisciplinary effort to model the Southern Ocean's response to anthropogenic forcing as a key priority.

SWOT satellite is a joint project of the European Union and United States to measure the ocean surface at unprecedented resolution

References

1. ASOC | Southern Ocean
2. Down To Earth | Giant waves, monster winds and Earth’s strongest current
3. PhyOrg | Mysterious Southern Ocean

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