

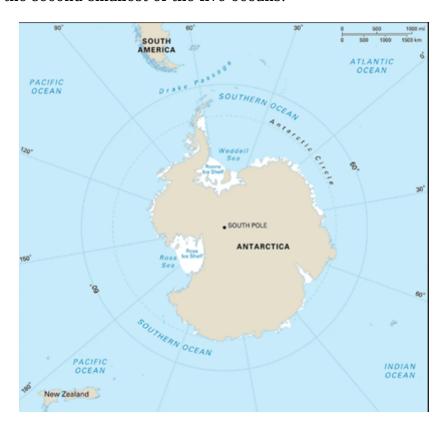
Southern Ocean

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.

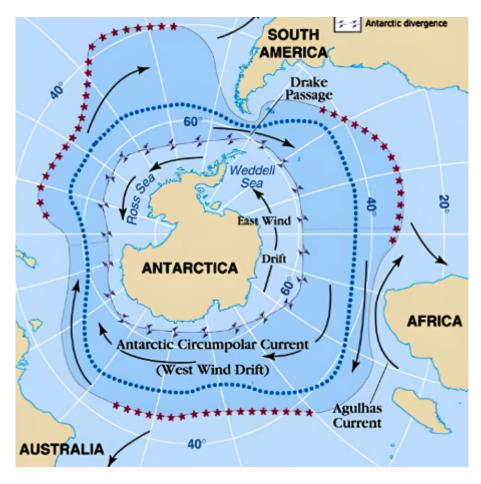


- Characteristics It experiences *Earth's strongest winds and largest waves*.
- It is home to <u>city-sized icebergs</u>.
 - Antarctic Ice Sheet is the largest ice mass on Earth, equivalent to 58 metres of the global sea level.
 - The ice sheet flows onto the Southern Ocean surface in the form of giant 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 <u>biggest ocean current</u> on the globe, as well as tiny turbulent flows that fit inside a teacup.
 - Antarctic Circumpolar Current (ACC)
 - Antarctic Slope Current
 - Sub-polar gyres
 - \circ 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 <u>ejects salt into the ocean surface</u> and this extra salt, in addition to cooling effects from the atmosphere, <u>makes the surface seawater heavier</u>/ 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 <u>lifted back to the ocean surface</u> 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 km².
- 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

