

Indian Ocean Dipole (IOD)

[UPSC Notes]

What is the Indian Ocean Dipole (IOD)?

An atmosphere-ocean-linked phenomenon known as the Indian Ocean Dipole (IOD) occurs in the Indian Ocean and is marked by a disparity in sea surface temperatures. The Indian Ocean dipole (IOD) is the difference in temperature between the Eastern (Bay of Bengal) and western Indian oceans (Arabian Sea). La Nina and El Nino are the other two similar ocean phenomena to IOD, that affect the monsoons in India.

According to scientists, the IOD is an ENSO-like coupled ocean-atmospheric event that occurs in the equatorial region of the Indian Ocean. It is believed that the IOD and ENSO occurrences are connected by other Walker circulation's westward expansion and its related Indonesian throughflow.

Features of IOD

IOD (Indian Ocean Dipole) arise as a result of a variety of atmospheric occurrences that affect the water's surface temperature. It starts in the equatorial regions of the Indian Ocean, develops in the months of April and May, and peaks in October.

- Cool water from the Indian Ocean rises in the east due to variations in temperature and wind.
- Warm and cold winds alternately blow in those directions. This is due to the pressure difference brought on by the temperature differences between the western and eastern portions of the Indian Ocean.

Phases of Indian Ocean Dipole (IOD)

The Indian Ocean dipole gives rise to 3 phases, namely, the positive phase, negative phase, and neutral phase.

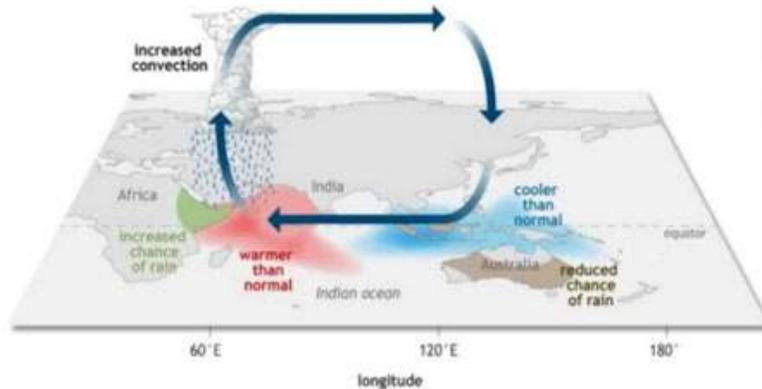
Neutral phase of IOD: The IOD neutral face is when water from the pacific ocean flows through Indonesian islands, keeping the oceans warmer to Australia's north-western direction. Westerly winds sweep along the equatorial belt as air rises above this region and stands through the western part of the Indian Ocean basin.

Positive Indian Ocean Dipole

Warm water can migrate to Africa during this phase because the westerly winds over the equator weaken. A surge of cold water from the deep ocean toward the east is also made possible by changes in the winds. During this, the tropical Indian Ocean has

temperature differences, with the east experiencing cooler than usual water and the west experiencing warmer than usual water. It has been determined that the monsoon will benefit from this occurrence. This results in a positive Indian Ocean dipole.

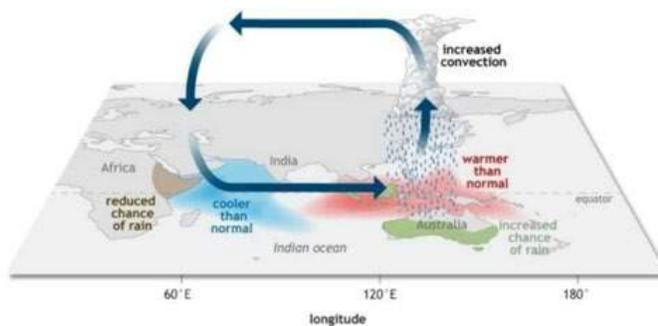
Positive Indian Ocean Dipole



Negative Indian Ocean Dipole

Negative phase of IOD: Warmer water accumulates towards Australia during this phase as the westerly winds along the equatorial line pick up speed. Due to this, the tropical Indian Ocean has temperature fluctuations, with the east experiencing warmer-than-normal water and the west experiencing cooler-than-normal water. This occurrence hinders the monsoon's progress over India.

Negative Indian Ocean Dipole



Impact of IOD on Southwest Monsoon

- Several studies have indicated that the central part of India receives more rain than usual during a good IOD year. The influence of El Niño Southern Oscillation (ENSO) was shown to be frequently encountered by a positive IOD index, resulting in enhanced monsoon rainfall in multiple ENSO years.
- On the other hand a negative IOD supports El Niño, which causes a severe drought.
- Simultaneously, the Arabian Sea has more cyclones and is normally due to a positive IOD. Intense than usual cyclogenesis (formation of tropical cyclones) occurs in the Bay of Bengal as a result of negative IOD. During this period, cyclogenesis in the Arabian Sea is reduced.
- So, an IOD has the potential to either strengthen or diminish the effect of El Niño on the Indian rainfall pattern. Despite an El Niño year, India may see good rains if the IOD is positive.

Impact of Indian Ocean Dipole on El Niño

Oceanic dipoles in the Indian El Niño may have an indirect impact on SST (sea surface temperature) anomalies and variations.

In the Pacific's extreme east, SST is higher due to the Indian Ocean dipole, which can cause and worsen a number of El Niño-like variations and irregularities.

The ENSO cycle and IOD can interact significantly, speeding up any noise effects.

Events like El Niño and La Niña are normal components of the world climate structure. When the Pacific Ocean and the atmosphere that surrounds it depart from their balanced state for several seasons, these events take place. While La Niña occurrences are the opposite, with a continuous cooling of these same regions, El Niño episodes are linked to the heating up of central tropical Pacific and Eastern tropical Pacific regions.

Impact of IOD on Australia

Australian summer crops may suffer as a result of a delayed monsoon, which would lead to a 28% fall in the planted area in the year 2019-20.

In Southern and central Australia, a positive is often accompanied by below-average winter-spring precipitation, as well as a more severe fire season in the South East Australian region.