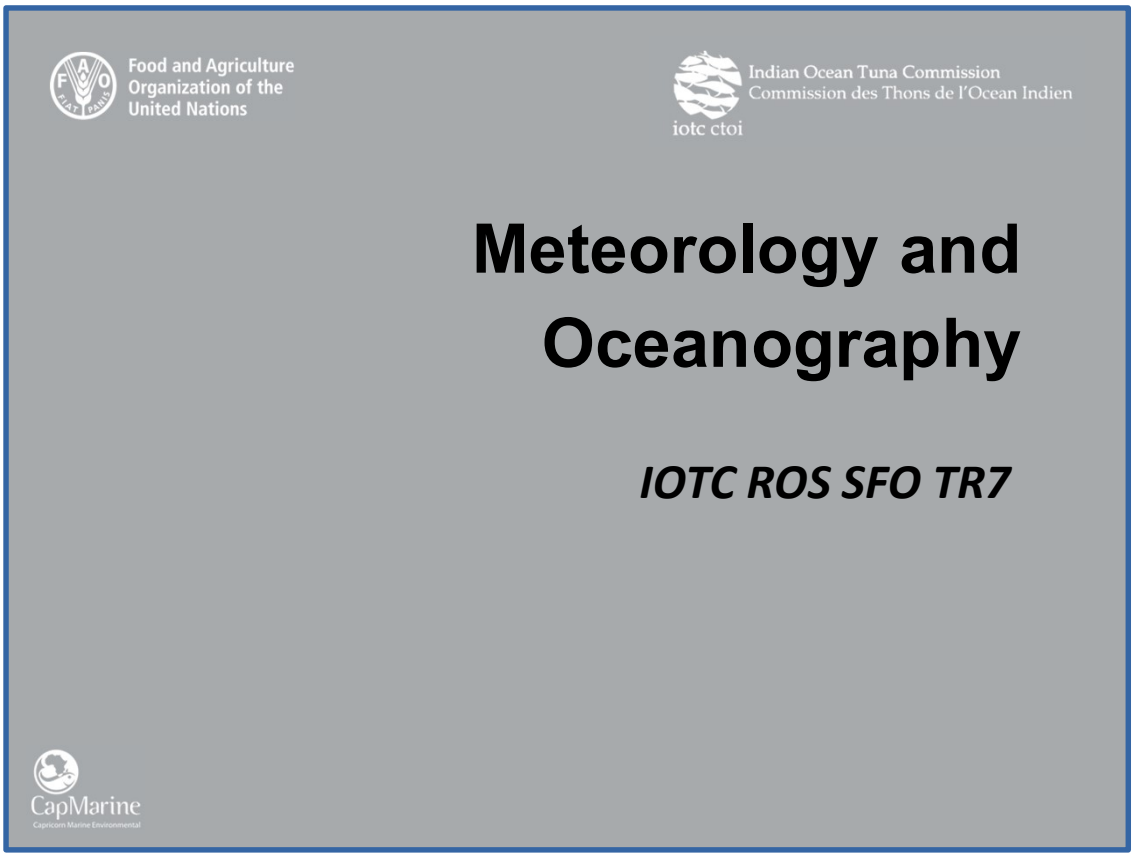


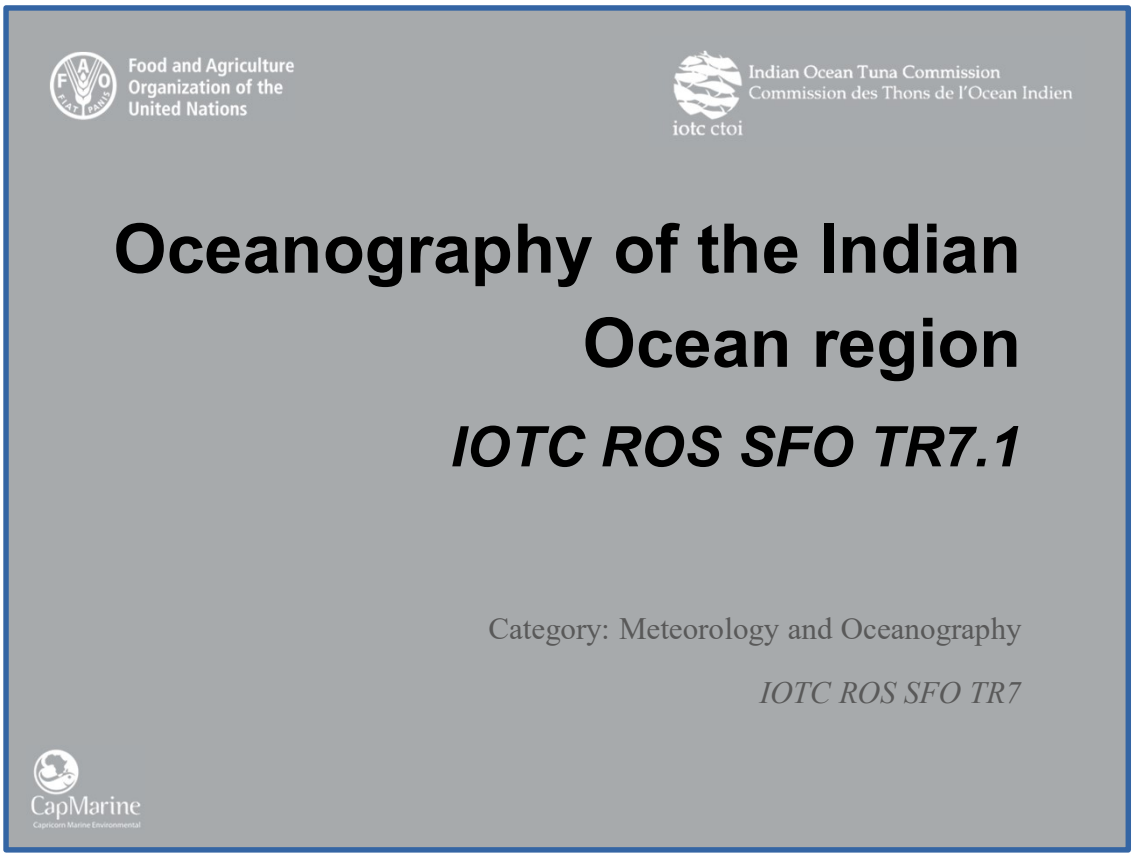
This module aims to provide trainees with the basic understanding the effect meteorology and oceanography parameters have on the environment in which they work, so they are able to collected and record information on how these forces affect fishing activities.

Trainee performance is evaluated against the following agreed IOTC ROS competency standards:

- Candidate is able to collect parameters of meteorology and oceanography
- Candidate as a practical knowledge of the Beaufort scale

The achieving of the standard is demonstrated by candidate capacity to collected and record:

- wind speed & direction
- use the Beaufort scale
- sea surface temperature



In this course trainees are to get familiar with the oceanography of the Indian Ocean region, and with the regional oceanic currents, seasonal winds and sea conditions that can influence the fisheries.

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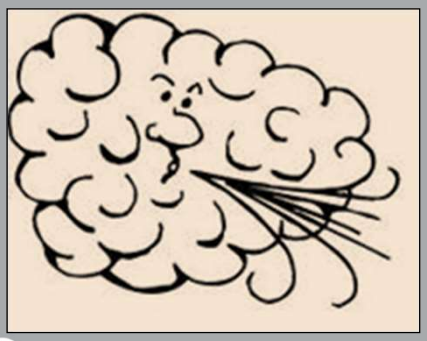
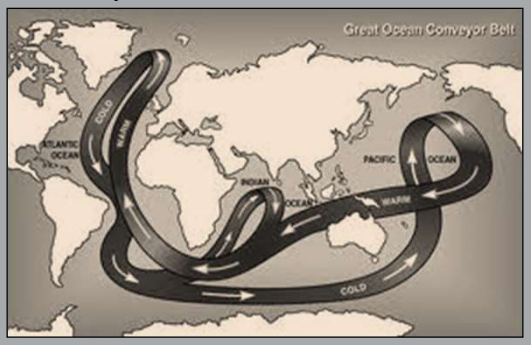
OCEAN CIRCULATION: Sun's energy

The sun's energy causes:

Circulation of the atmosphere (winds), and



Variations in temperature and salinity of seawater



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(temperature and salinity controls the water's density – thermohaline circulation)

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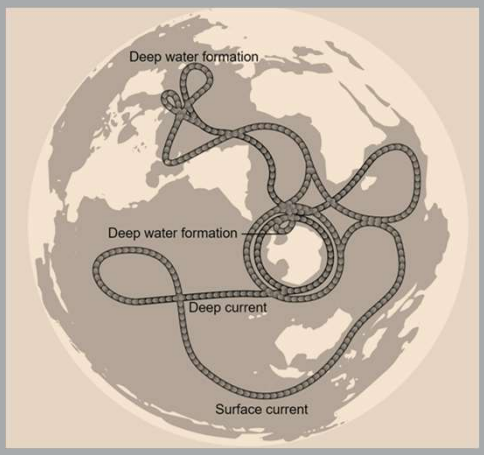
Ocean Currents



Global conveyer belt (https://en.wikipedia.org/wiki/File:Conveyor_belt.svg)

- Continuous, directed movement of sea water, primarily driven by winds and by seawater density, although many other factors – including the shape and configuration of the ocean basin they flow through – influence them.
- An ocean current flows for great distances and together they create the global conveyor belt.
- Ocean currents are patterns of water movement that influence climate zones and weather patterns around the world.
- Two basic types of currents – surface and deep-water currents.

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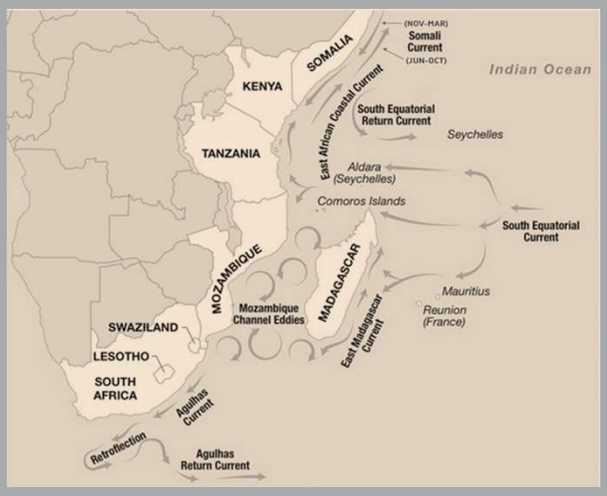
Indian Ocean Currents



- ✓ 3rd largest ocean
- ✓ Large part lies within the tropics
- ✓ Indian ocean basin north of the equator limited by the Asian landmass
- ✓ IO currents do not follow the same pattern as in other oceans
- ✓ Major currents at the equator are the south equatorial currents

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The Indian Ocean is the third largest ocean and covers about 14% of the Earth's surface area. Because much of the Indian Ocean lies within the tropics, this basin has the warmest surface ocean temperatures (20 - 30°C). However, the extent of the Indian ocean basin north of the equator is limited by the Asian landmass and currents in this region do not follow the same pattern as other ocean basins such as the Atlantic and Pacific.

The major currents at the equator are the south equatorial currents, flow towards the west parallel to the equator. The South Equatorial Current splits into a south-flowing arm, becoming the South East Madagascar Current and the Mozambique Current. A portion of the south equatorial current also turns north forming the North East Madagascar Current and the East African Coastal Current. The latter flows as far as the Somali Current, after which its direction depends on the season.

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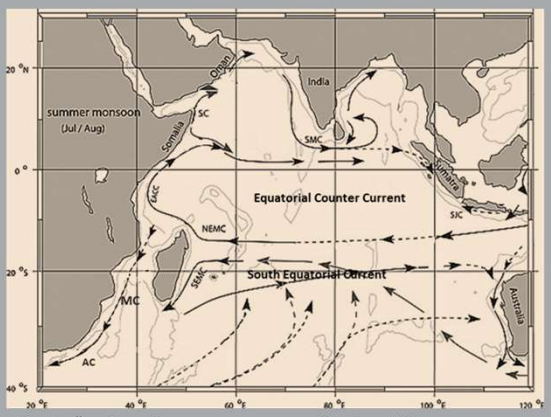
Indian Ocean Currents and the Monsoon

A monsoon is a seasonal reversal in the prevailing wind direction and weather



AC – Agulhas Current
EACC – East African Coastal Current
MC – Mozambique Current
NEMC- North East Madagascar Current
SC – Somali Current
SEMC – South East Madagascar Current
SMC – South Monsoon Current

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- ✓ Monsoon caused by the projection of the Indian landmass into the in the Indian Ocean
  - ✓ **SE monsoon: northerly flow and range of the EACC increases**
  - ✓ **NE monsoon: northerly flow and range of the EACC reduces**
- ✓ Influences the strength and direction of coastal currents
- ✓ During the SE monsoon (summer months) upwelling occurs along the Somali and Arabian Peninsula and the region becomes a highly productive fishing area.

Monsoon season and winds are caused by the projection of the Indian landmass into the in the Indian ocean. A monsoon is a seasonal reversal in the prevailing wind direction and weather. A warm air mass with low pressure at the surface forms over the continent as it is warmed by the sun. Air from the relatively cooler and higher-pressure air mass over the ocean then flows toward the low pressure over land. In winter this process is reversed as the air over the land becomes cooler, developing into a high pressure and winds blow off-shore towards the low pressure caused by the relatively warmer ocean. These conditions also influence the strength and direction of coastal currents.

During the SE monsoon the flow of the EACC is increased by 4knots and it range extends further north becoming the Somali current and later joins the Indian monsoon current. During the NE monsoon the northerly flow of the EACC is reduced to less than 1 knot in places and its course is diverted eastwards lowing back into the IO becoming the equatorial counter current.

During the SE monsoon (summer months) , uupwelling occurs along the Somali and Arabian Peninsula where nutrient-rich water provides a source of nourishment for phytoplankton which feeds the zooplankton. The massive concentration of sardine and other small pelagic fish, which feed on the zooplankton form the basis of the seasonal and highly productive fishery in this area. Most of the other parts of the Indian Ocean experience down-welling and the surface water is generally nutrient poor.

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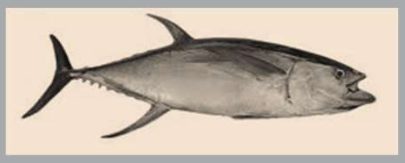
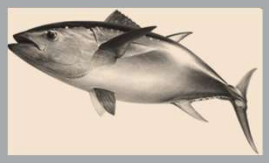
How does the IO climate influence fishing?

- There is 20 % reduction in fish landings during the NE monsoon (winter months)
- Between monsoon seasons the heavy rainfall correlates with high fish landings
- Higher nutritional concentrations match with the SE monsoon cycle (summer months)





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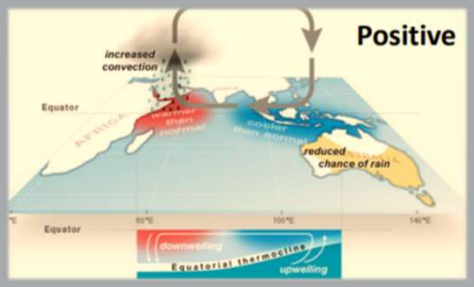
The Indian Ocean Dipole (IOD) Phases

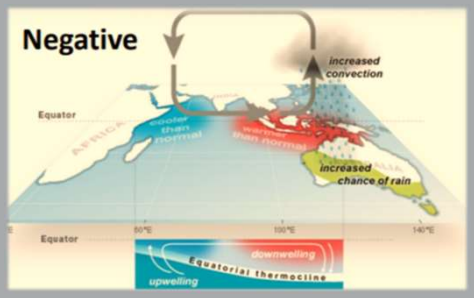
POSITIVE PHASE:

Warming of SST in the western Indian Ocean region and brings heavy rainfall over east Africa and severe droughts / forest fires over the Indonesian region



NEGATIVE PHASE:

The opposite conditions, with warmer water and greater precipitation in the eastern Indian Ocean, and cooler and drier conditions in the west.



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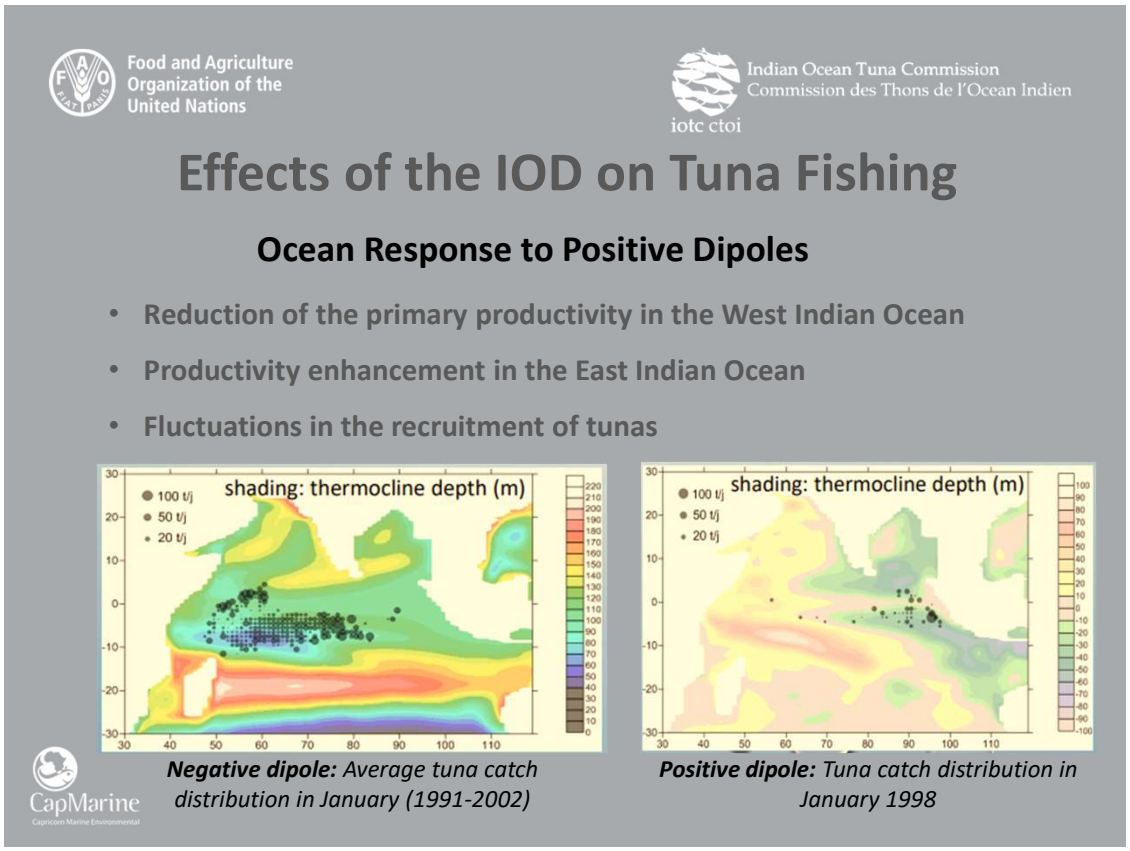
The Indian Ocean Dipole (IOD) is a coupled ocean-atmosphere phenomenon in the Indian Ocean. It is normally characterized by anomalous cooling of SST in the south eastern equatorial Indian Ocean and anomalous warming of SST in the western equatorial Indian Ocean. Associated with these changes the normal convection situated over the eastern Indian Ocean warm pool shifts to the west and brings heavy rainfall over the east Africa and severe droughts/forest fires over the Indonesian region. An average of four each positive/negative IOD events occur during each 30 year period with each event lasting around six months.



Variation in the abundance and distribution of tuna are well known to be associated with environment parameters that drive large-scale climatic indices such us Indian Ocean Dipole. Warm and cold events in the western Indian Ocean induced by the IOD drive changes in the marine environment such as primary production and the mixed-layer depth with consequences for tuna abundances (Corbineau et al. 2008; Marsac 2008). During positive dipoles there's a reduction of the primary productivity in the west Indian ocean and a productivity enhancement in the east Indian ocean. Tuna catch rates have been observed to decrease in the western Indian Ocean during positive IOD events and increase in the east Indian ocean (Marsac and LeBlanc 2000; Menard et al. 2007; Marsac 2008).

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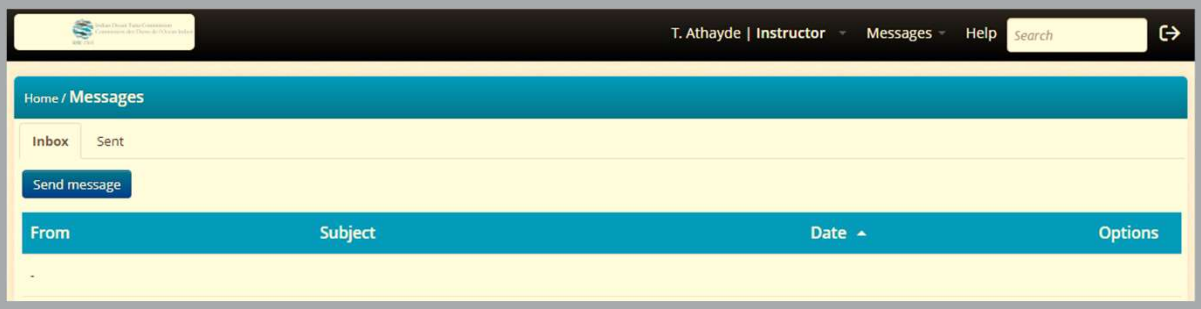
ANY QUESTIONS?



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