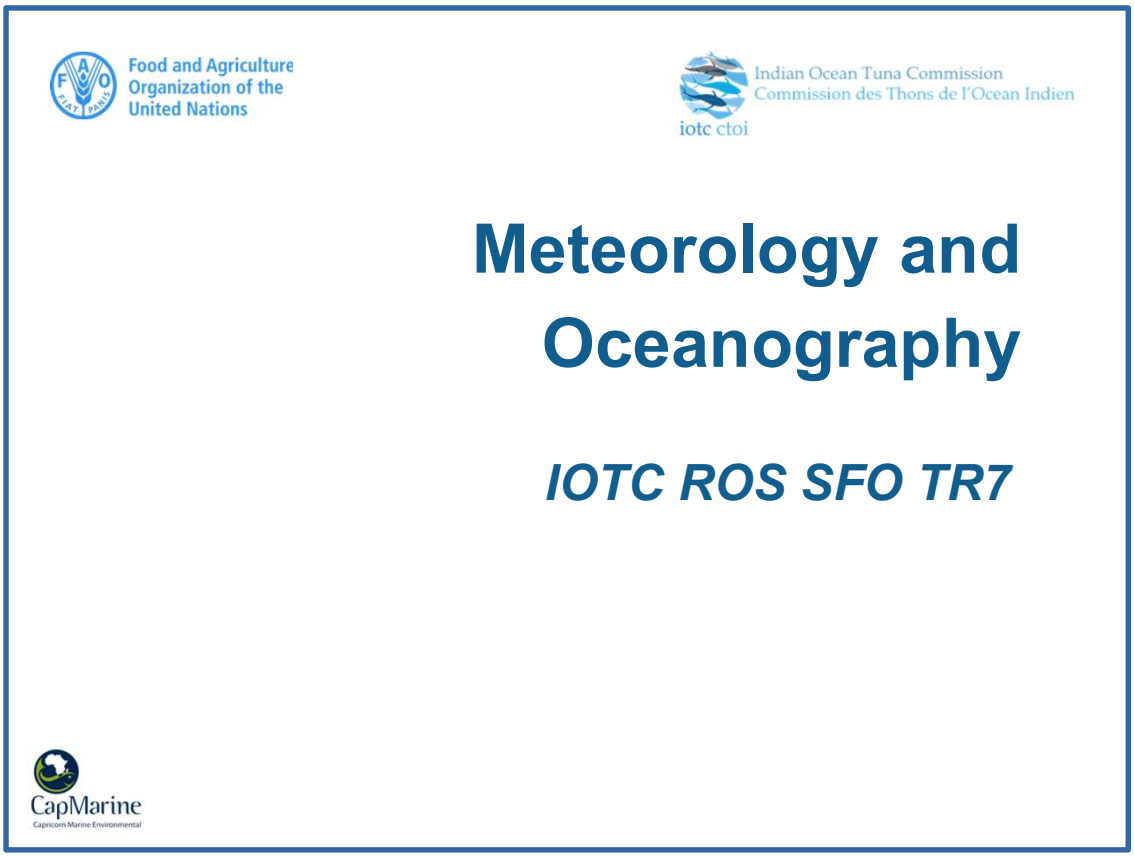


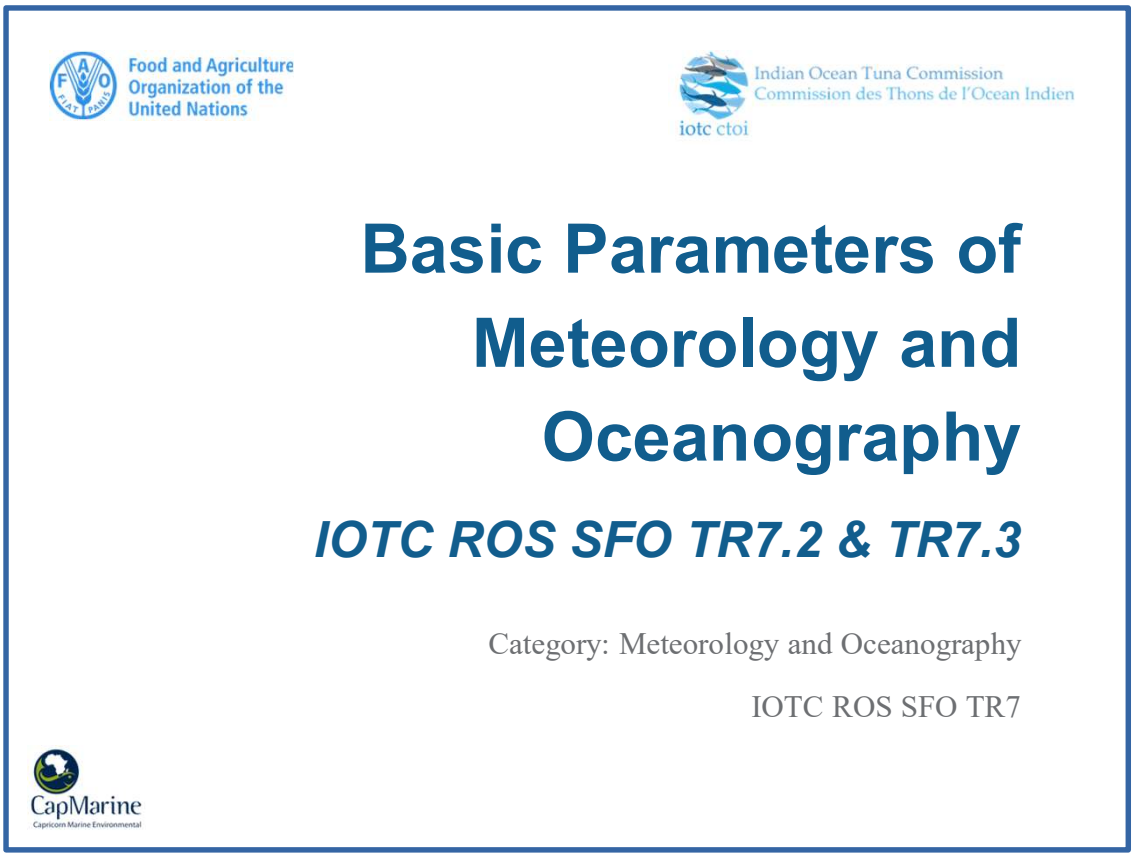
This module aims to provide trainees with the basic understanding the effect meteorology and oceanography parameters have on the environment in which they work, so they are able to collected and record information on how these forces affect fishing activities.

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 will learn the basic parameters of meteorology and oceanography relevant to scientific fisheries observers and how to record them if and requested to.

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Basic Parameters of Meteorology and Oceanography

- Air pressure (barometric pressure)
- Wind speed and direction
- Sea state (sea waves and swell height and direction)
- Beaufort scale
- Sea surface temperature and colour
- Major ocean currents

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Barometric Pressure

The pressure at any location on the Earth, caused by the weight of the column of air above it.

1013.25 (mbar or hPa) at sea level

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The atmospheric pressure (barometric pressure) at any location on the Earth, caused by the weight of the column of air above it. Pressure is and is measured in millibars (mbar). The average pressure at sea level is (1013.25 mbar). Air pressure is measured using a barometer.

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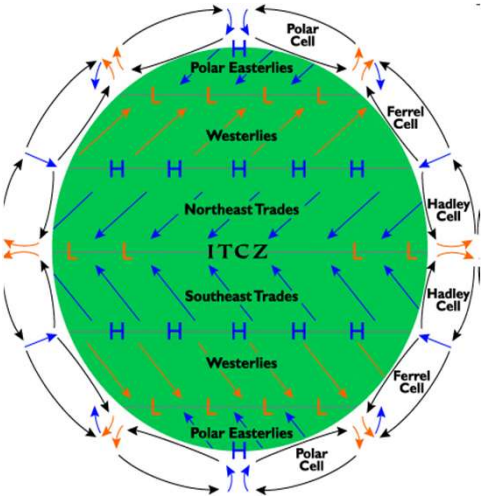
Barometric Pressure



- Air heavier due to lower temperatures sinks downwards creating higher pressure zones.
- Air lighter due to higher temperatures raises creating a lower pressure zones.
- The wind is created by the movement of air from high to low pressure zones.

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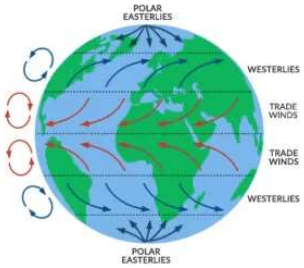
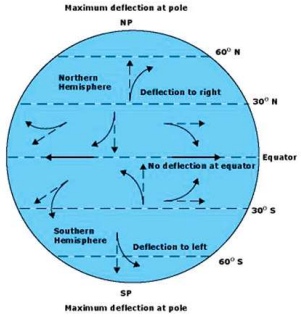
The atmospheric pressure (barometric pressure) at any location on the Earth, caused by the weight of the column of air above it. Pressure is and is measured in millibars (mbar). *The average pressure at sea level is (1013.25 mbar*) Air pressure is measured using a barometer. A higher pressure occurs when air heavier due to lower temperatures is sinking downwards (descending). A lower pressure occurs when air is warmed up by the sun or high-water temperatures and the warm air rises. The horizontal movement of air from the high pressure to low pressure creates the wind. Essentially wind is the horizontal movement of air from a high-pressure system to a low-pressure system.

Barometric Pressure

- **Trade winds** are the main global wind system that move air from the high-pressure regions to the low-pressure regions.
- The rotation of the earth causes the wind to be deflected to the west. This deflection the Coriolis force results in **SE trade winds** in the S hemisphere and **NE trade winds** in the N hemisphere.





Globally the main wind systems are the trade winds that move cool air from the high-pressure religions of the higher latitudes to the low-pressure region near the equator where the more direct sunlight causes the air to warm up and rise. The rotation of the earth causes the wind to be deflected to the west. This deflection (Coriolis force) result in south east trade winds in the southern hemisphere and north east winds in the northern hemisphere.

The strength of the wind is determined by the pressure gradient. A steep gradient caused by a rapid change in pressure over a short distance will result in a stronger wind.

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Wind Direction and Speed

The **wind direction** is determined by the direction ***from*** which the wind is blowing.

If you are facing into the wind the direction you are looking will be the wind direction.

For example, a northerly wind blows from the north to south

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Wind has a large effect on conditions at sea that affect fishing operations and large number of oceanic conditions such as currents and water temperature.

Observer might be requested to register wind direction when at-sea. The wind direction is always recorded as the direction that it is coming from. Therefore, if you are looking into the wind and facing east it will be an east-wind.

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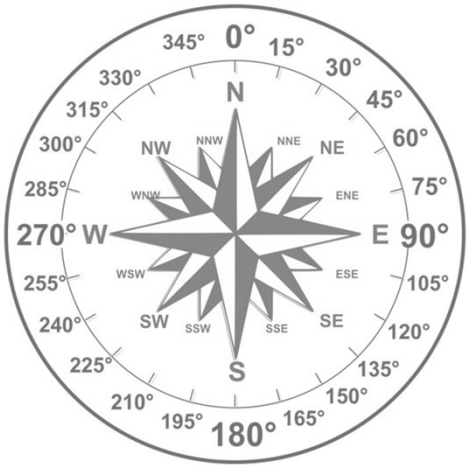
Recording Wind Direction



It can be expressed in either cardinal units or in degrees.

For example:

South Easterly Wind

- SE
- 125°

Westerly Wind

- W
- 270°

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The Wind Direction can be expressed in either cardinal units or in degrees

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Wind Speed

Wind speed can be expressed in a number of units:

1. **Force (Beaufort Wind Scale)** *
2. **Knots (nautical miles per hour)** *
3. Kilometres per hour (km/h)
4. Meters per second (m/s)
5. Described in words

*Relevant units

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Observer might be requested to register wind speed when at-sea. The standard measurement of wind speed at sea is either *Knots* or *Beaufort Wind Scale* (force number). By observing the sea state an estimation of the wind speed can be determined.

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Beaufort Scale

Beaufort No.	Name	Wind Speed (Knots)	Wave Height (Meters)	Visible Sea State
0	Calm	0 to 1	0	Sea is like a mirror
1	Light Air	1 to 3	0.1 to 0.2	Ripples with appearance of scales: no foam crests: sea still has glassy appearance.
2	Light breeze	4 to 6	0.3 to 0.5	Small wavelets: crests have glassy appearance but do not break.
3	Gentle breeze	7 to 10	0.6 to 1.0	Large wavelets: crests begin to break: few scattered white horses.
4	Moderate breeze	11 to 16	1.5	Small waves, becoming longer: fairly frequent white horses.

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The Beaufort wind force scale is an empirical measure that relates wind speed to observed conditions at sea or on land. The scale starts with 0 and goes to a force of 12, to represent the wind strength from calm (force 0) to the hurricane (force 12).

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Beaufort Scale

Beaufort No.	Name	Wind Speed (Knots)	Wave Height (Meters)	Visible Sea State
5	Fresh breeze	17 to 21	2.0	Moderate waves, longer form: many white horses and scattered spray.
6	Strong breeze	22 to 27	3.5	Large waves forming, white foam crests extensive everywhere and spray.
7	Moderate gale	28 to 33	5.0	Sea starts to heap up and white foam breaking waves begin to be blown in streaks: spindrift begins to be seen.
8	Fresh gale	34 to 40	7.5	Moderately high waves of greater length, edges of crests break into spindrift: foam blown into well-marked streaks.

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Beaufort Scale

Beaufort No.	Name	Wind Speed (Knots)	Wave Height (Meters)	Visible Sea State
9	Strong gale	41 to 47	9.5	High waves; dense streaks of foam; sea begins to roll; spray begins to affect visibility.
10	Whole gale	48 to 55	12.0	Very high waves with overhanging crests; sea surface takes on white appearance as foam in great patches is blown in very dense streaks; rolling sea and visibility reduced.
11	Storm	56 to 64	15.0	Exceptionally high waves; sea covered with long white patches of foam. Small and medium sized vessels lost to view between waves. Visibility further reduced.
12	Hurricane	64 +	15 +	Air filled with foam and spray; sea completely white with driving spray; visibility greatly reduced.

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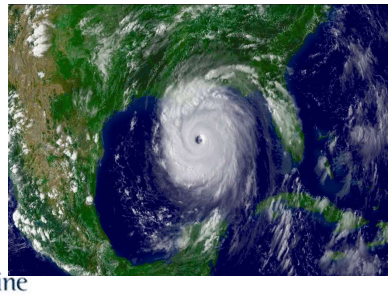
Beaufort Scale Example:

Scale: 12

Description: Hurricane

Conditions: The air is filled with foam and spray. Sea completely white with driving spray. Visibility very seriously affected.

Wind Speed: 64+ knots



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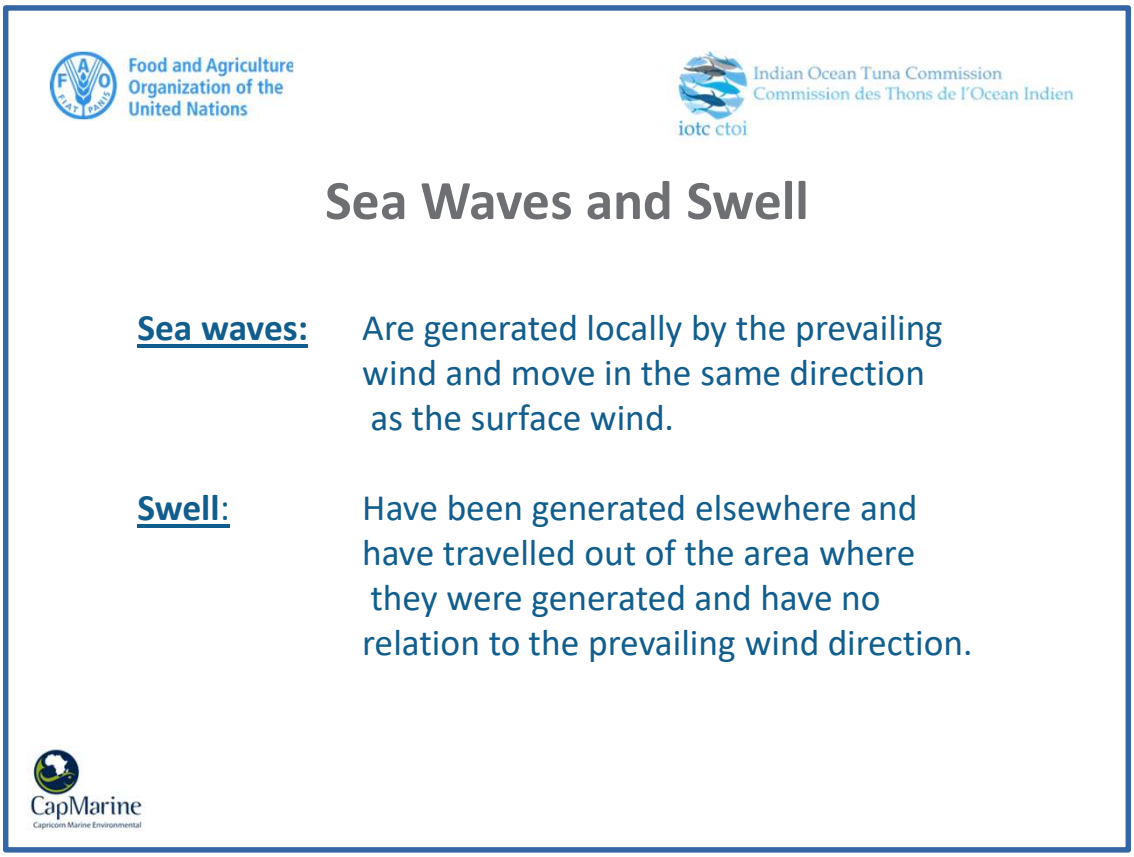

Waves of both types appear to travel in groups consisting of a number of waves of varying height with the higher wave occurring in the centre of the group. A relatively flat area consisting of a number of distinctly smaller waves separates groups or sets of waves.

Wind waves have an irregular form while swell waves will have a more regular form. Note a large swell can often be present with little or no wind blowing and no sea waves present.

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Sea Waves and Swell Direction

The **waves/swell direction** is determined by the direction **from** which the waves/swell is coming.


Fishing vessel in heavy seas

Sea direction

- Can be recorded with cardinal points or degrees.

If you are facing into the wave/swell the direction you are looking will be the wave/swell direction.

For example, a easterly swell comes from the east to the west.

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Sea direction, is expressed as the direction from which the sea is coming. Cardinal points or degrees are also used to record the direction of the sea, similar to wind direction.

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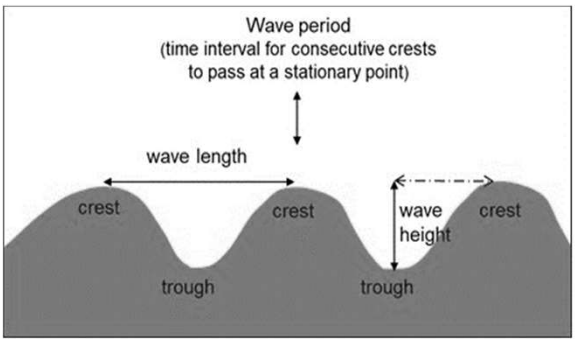
Sea Waves and Swell Height

The **sea waves/swell height** is the height from the trough to the crest of the wave.



- Expressed in **meters**
- Estimated as an average
- Estimated by looking at an object on the sea surface, watch it move as a number of waves pass and attempt to estimate the height of its vertical movement.

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Sea height is expressed in meters and is the height from the trough to the crest of the wave. This height can be estimated by looking at an object on the sea surface (for example a bird or white patch from a recently broken wave) and watch it move as a number of waves pass and attempt to estimate the height of its vertical movement. As the heights vary from wave to wave an average is estimated. With time and experience you will become more accurate with your estimations. The wave height and sea condition also form a cross-reference to estimating wind strength. Swell direction and height are estimated in the same way as determining sea height and direction. However, a swell will never break or have a "white cap" and has no relation to the prevailing wind. In many cases the swell direction will be different from that of the prevailing sea. If two wave forms are observed and their movement is in the direction of the surface wind, the system, which has the longer distance between crests and a more regular form, is considered to be the swell.

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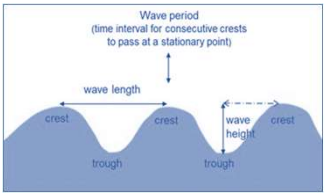
Sea Waves Height Example:

1. In reference to the figure below the height of the wave was estimated by looking at the surfer and recorded in meters.

Wave height: **<u>30 meters</u>**



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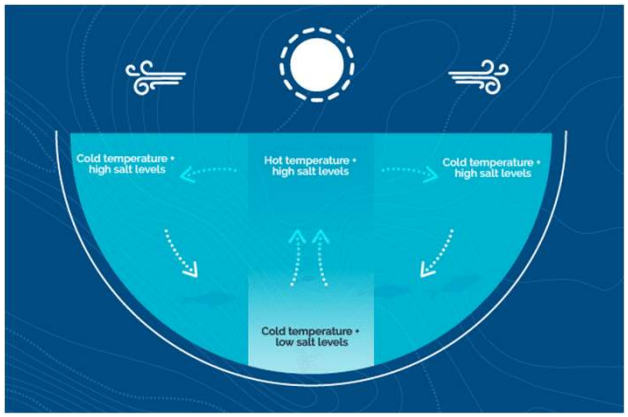
Currents



- A current is a displacement of sea water characterized by its direction, speed and flow.
- The force of wind on the sea surface causes the surface water to move in the same direction as the wind.
- Similar to wind, currents are influenced by the rotation of the earth (Coriolis force).

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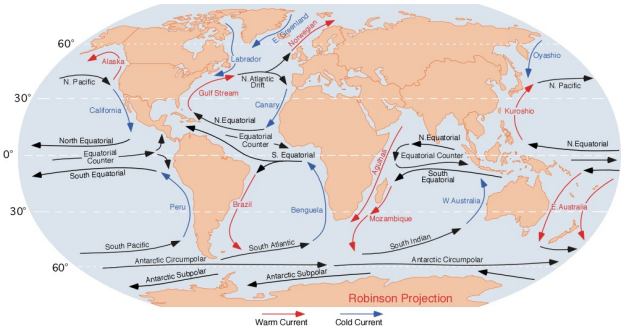
A **marine current** is a regular, continuous, cyclic movement of sea water. It is created by the combined action of constant winds pushing the surface water, as well as by the tide and the **Coriolis force** which changes the direction of currents according to the hemisphere. As a reminder, the Coriolis principle is an effect whereby the trajectory of a moving object on the surface of the Earth is deflected. The current is also created by the numerous **differences in temperature.**

Currents Direction

The **ocean current direction** is the direction they're headed for or where the current is flowing towards.



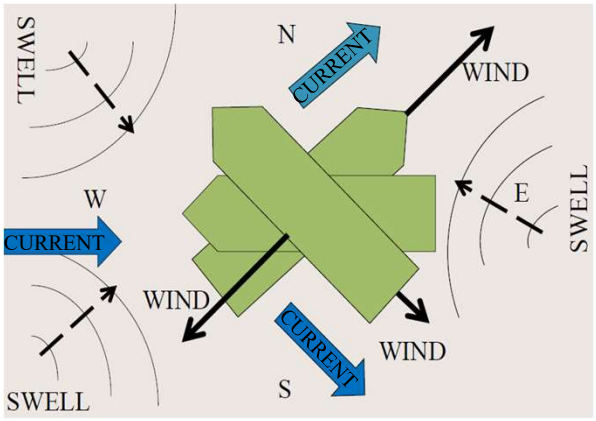
Current direction

- Can be recorded with cardinal points or degrees.

If you are facing into the current the direction you are looking will be the opposite to the current direction.

For example, a easterly current comes from the west and flows to the east.

Wind, Swell and Current Direction



- **Wind direction:** the direction from which the wind is blowing.
- **Swell direction:** the direction from which the swell is coming.
- **Current direction:** the direction where the current is flowing towards.

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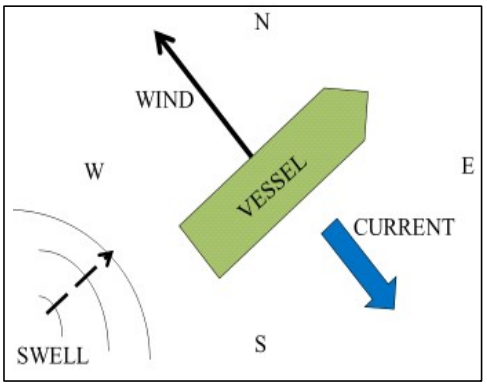
Wind, Swell and Current Direction Example:

1. In reference to the figure below the direction of the wind, swell and current were recorded in degrees and cardinal points:

Wind	**SE or 135°**
Current	**SE or 135°**
Swell	**SW or 225°**



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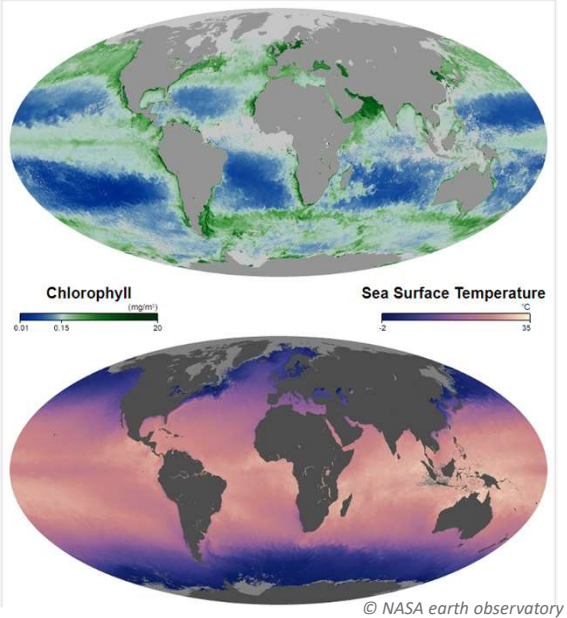
Sea-surface Temperature (SST) & Chlorophyll

- Important parameter in fishery
- Expressed in degrees (°)
- Water temperature associated with water colour:
  - ✓ **cold water** (nutrient/oxygen rich) → chlorophyll green colour → often closer to shore
  - ✓ **warm water** (nutrient/oxygen poor) → clear blue → often away from the shore



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Sea surface temperature (SST) in an important parameter measured in the tuna fishery. Vessels target thermal fronts where there is a sudden change in SST.

Also associated with water temperature is the **water colour**. When cold, nutrient-rich, oxygen-rich water is upwelled there is an increase in primary activity (phytoplankton blooms) and an increase in concentrations of "green water" (water with high concentrations of chlorophyll). This is often clearly discernible from the warm clear blue oceanic water.

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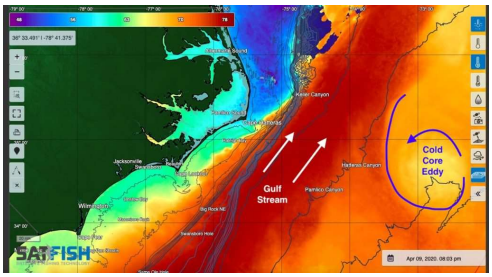
SST & Chlorophyll Example:

- SST maps show where water temperatures are right for the species the fishing vessels is targeting.



The SST map shows major warm-water currents like the Gulf Stream, along with productive, nutrient-rich cold core eddies that attract gamefish.

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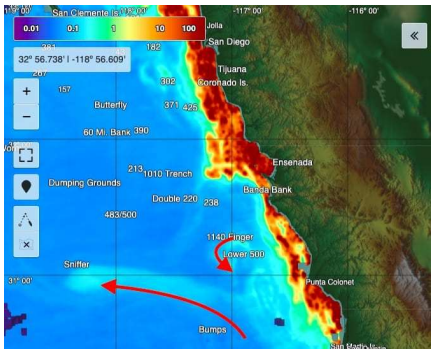
- Chlorophyll maps show where chlorophyll is produced by the phytoplankton.



The Chlorophyll map shows chlorophyll filaments that jet off the coast and spin into eddies deliver plankton-rich coastal water offshore, attracting bait and fish like tuna.

SST maps can show where water temperatures are right for the species the fishing vessels is targeting. Each species has a preferred temperature range, and pelagic species (such as tuna) move around with the water circulation to stay within that range. Using satellite SSTs helps fisherman to find the areas that have the right temperature for the target species – both where they can be found, and where they are expected to come to the surface and/or to eat the bait or jig.

Chlorophyll maps show where chlorophyll is produced by the phytoplankton. Zooplankton eat phytoplankton, small baitfish eat zooplankton, and so on up the food chain to pelagic fish. The trade off is that lots of chlorophyll also makes the water a murky green colour, which makes it easier for baitfish to hide from bigger predators.

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Electronic Fishing Aid(s)

Current Direction & Speed

Doppler Current Meter
Displays the direction and strength of the current at various depths.

Wind Direction & Speed

Weather facsimile
Supplies vessels with weather information, including wind direction and strenght .

SST

Sea Surface Temperature (SST) gauge
Mechanical or electronic thermometer measuring the sea surface temperature

Current, Wind, Sea, SST & Chlorophyll

Fishery information services (FIS)
Instant information on weather and oceanographic features (SST, phytoplankton densities or sea height)

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Electronic fishing aid(s) used to obtain current, wind & sea direction & speed, SST and Chlorophyll information will be found in the vessel bridge or in a room off the bridge.

The **doppler current meter** displays the direction (in units of degrees) and strength (in units of knots) of the current at various depths. Only circle "Y" if and independent current meter is on-board as other devices can be used to ascertain current speed. The handheld or automatic **expendable bathythermographs** (XBT) are periodically used to determine the depth of the thermocline. The **Sea Surface Temperature (SST)** gauge is a mechanical or electronic thermometer measuring the sea surface temperature that is usually mounted on the bridge. The **weather facsimile**, supplies vessels with weather information. The **fishery information services (FIS)** provides vessels with instant information on weather and oceanographic features (SST, phytoplankton densities or sea height).

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ANY QUESTIONS?

send us a message via Talents LMS

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