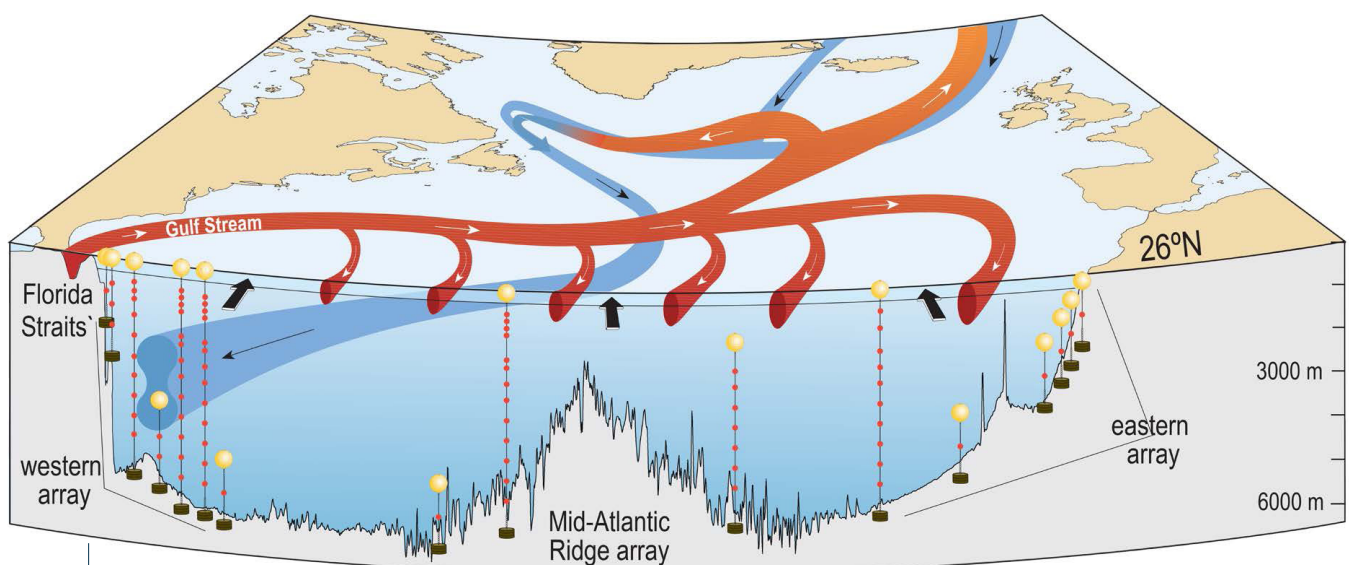


Ocean Currents

The waters of the ocean are constantly moving, from the surface right down to the abyssal depths kilometres below. Surface ocean currents are driven by the winds and transport heat from the equator towards the poles, releasing heat and moisture into the atmosphere along the way. Warm water from the tropics reaches north where it meets cold water from the high latitudes and forces the cold water to sink to the ocean depths where it travels towards the equator. This system of surface and deep currents acts like a giant conveyor belt that transports heat, salt, nutrients and dissolved gases, such as carbon dioxide and oxygen, around the world's oceans.

The currents at the top of the ocean are driven by the winds and the lower currents are driven by differences in salinity and the temperature of the seawater. A journey around this giant conveyor belt can take hundreds of years. This global conveyor has a strong influence on how our planet responds to increasing levels of atmospheric carbon dioxide (CO₂) as it interacts with the global carbon cycle to remove carbon dioxide from the air and store it in the deep ocean.



Schematic of the Atlantic Meridional Overturning Circulation (AMOC)

In some locations the flow of surface currents makes room for the colder water below to come to the surface, to 'upwell'. This water is much colder than the surrounding surface waters so it is easy to see in satellite images of sea surface temperature. This water is rich in nutrients like nitrogen and phosphorous compounds, so the regions where it surfaces have high phytoplankton production. The phytoplankton are grazed by zooplankton and small animals that are in turn eaten by fish so the 'upwelling' regions are full of marine life. Scientists can see this by using colour images of chlorophyll concentration (a measure of phytoplankton abundance).

When phytoplankton die they sink slowly down into deep water, along with dead or dying animals, faecal matter and inorganic dust. They are either eaten by animals or decompose, releasing their stored nutrients into the waters of the deep ocean. Upwelling currents bring these nutrients back to the surface. In the subtropics, strong solar heating, low winds and slow currents mean there is little mixing between the surface waters and the deep ocean and therefore the return of nutrients is slow, resulting in low phytoplankton populations.

Sometimes though these nutrient rich conditions lead to a rapid increase in the population of toxic or harmful phytoplankton, which can have a huge adverse effect on aquatic organisms and lead to large-scale mortality events. These toxins can cause the death of animals and animals can also die because of oxygen depletion in the water column. When the bloom is over, the phytoplankton die and sink. As they decompose they use all the oxygen in the water and bottom dwelling animals suffocate if they cannot escape. As the dying animals decompose they often produce toxic hydrogen sulphide, and on occasion, sulphurous gases can escape from the sediment and rise towards the sea surface in huge eruptions that can kill billions of fish. Harmful algal blooms can be seen from space and come in a wide variety of colours.