

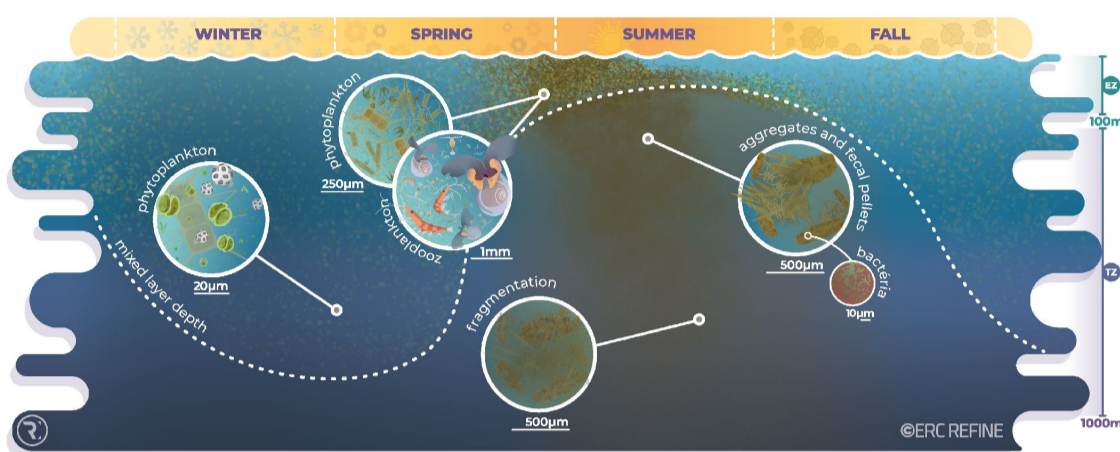
THE BIOLOGICAL CARBON PUMP



Controlled by living things...

Several biological and physical phenomena contribute to sequestering carbon in the deep Ocean. Here, life processes drive the transport of carbon...

... through falling particles "the gravitational pump"



In spring, the mixed layer rises towards the surface. Light is intense at this time of year, so conditions are optimal for phytoplankton growth: a bloom develops and herbivorous zooplankton take advantage of this abundance of food.

Naturally, these planktonic animals produce excrement (or faecal pellets), rich in organic carbon. Gravity will draw this excrement, as well as phytoplankton aggregates not consumed by zooplankton, quickly to the depths (around 100 metres per day). This fall of particles corresponds to the gravitational pump. As these particles fall, they may be consumed or else fragmented by bacteria. Unfragmented particles will continue to sink to the depths where they can be locked up in sediments.

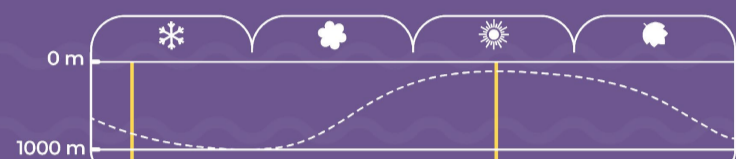
What is measured by the profiling float?



biogeochemical sensor

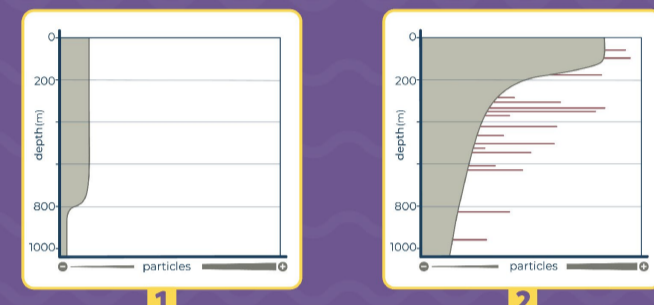
The represents a profiling float's resurfacing journey, during which its sensor has measured a property. It produces a **profile**.

This sensor evaluates the proportion of small and large particles between 0 and 1000 m deep.



profile

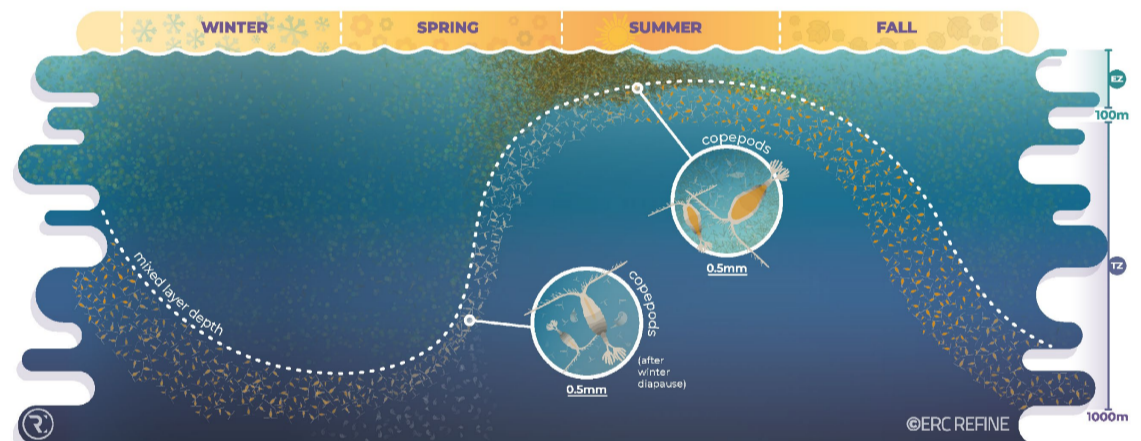
Examples of results obtained, thanks to the profiling float, for studying the gravitational pump.



small particles
large particles

There are more large particles in the Twilight Zone following a bloom. This is an effect of the gravitational pump.

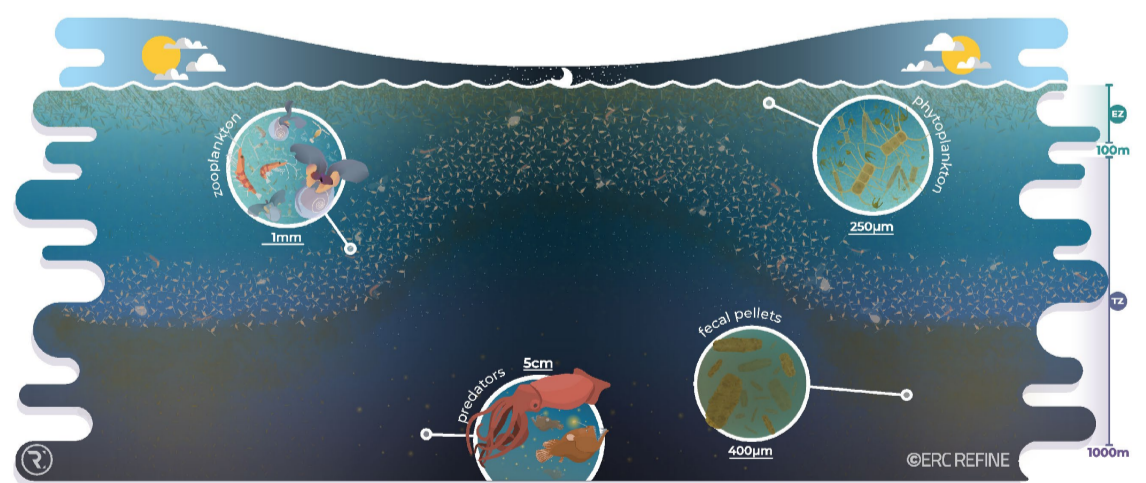
... by migrations "seasonal migration"



Some zooplankton species migrate to the depths to hibernate in or below the Twilight Zone. In this way, they contribute to carbon sequestration.

For example, certain copepods migrate, in spring, towards the surface, where their food is very abundant. They continue to feed at the surface throughout summer and thus accumulate large quantities of fats, extremely rich in organic carbon. In autumn, they then embark on their migration to the depths, following the base of the mixed layer. During winter, they survive thanks to their fat reserves, and release CO₂ by breathing. Some may die, and their carcasses will gradually sink to greater depths, thus amplifying the carbon sequestration effect.

"diurnal (day/night) migration": the planet's most massive animal migration



At sunset, many zooplankton species migrate to the Ocean's surface where they feed on phytoplankton, before returning to the Twilight Zone at dawn: this is a diurnal migration pattern.

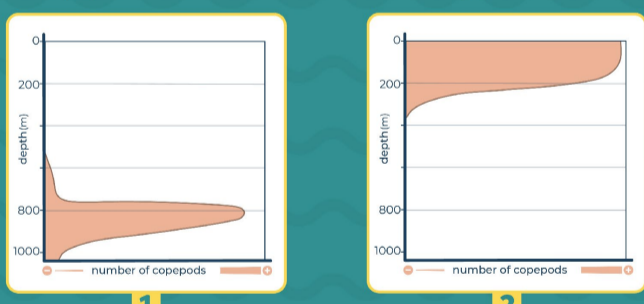
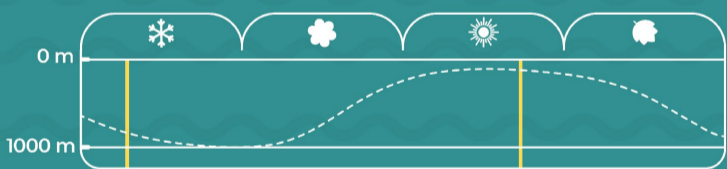
This phenomenon is primarily due to a balance struck between the need to feed and the need to keep away from predators. It is an efficient mechanism for actively transporting organic matter from the surface to the Twilight Zone where it is released in the form of faecal pellets. This excrement will then sink and be transported to greater depths. In this respect, diurnal migration amplifies the gravitational pump and the biological carbon pump.

What does the profiling float measure?



underwater camera

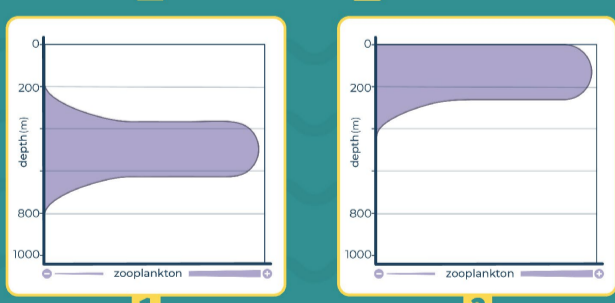
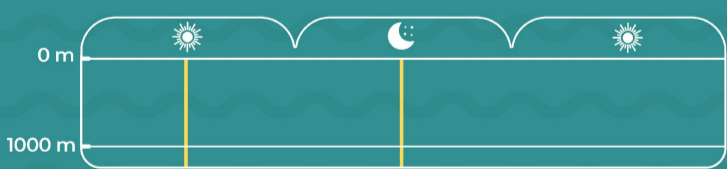
It allows estimation of the density and size of zooplankton and particles present in the water column.



profile

Examples of results obtained, thanks to the profiling float, for studying zooplankton migration phenomena.

The profiles allow the visualization of zooplankton movements between 0 and 1000 m depth on a seasonal (above) or daily (below) scale.



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