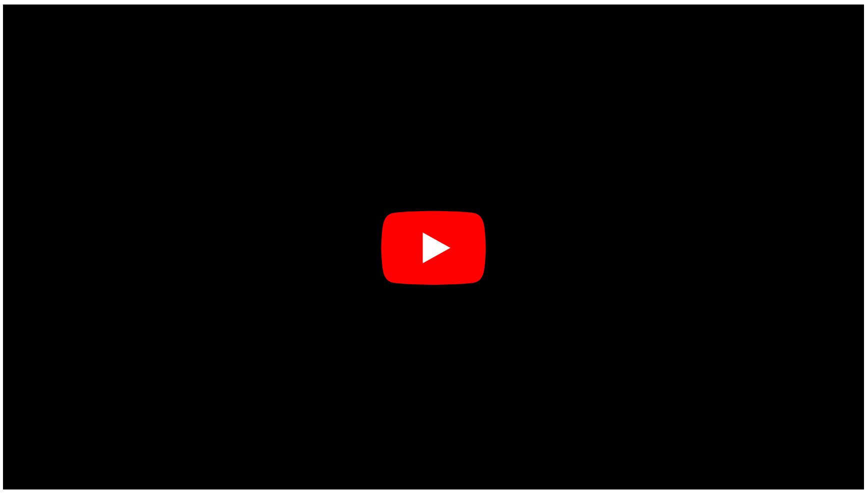
VIDEO INCLUDED

Why Oceanâ€™s Biological Carbon Pump Has Been Drastically Underestimated

Every spring in the Northern hemisphere, the ocean surface erupts in a massive bloom of phytoplankton. Like plants, these single-celled floating organisms use photosynthesis to turn light into energy, consuming carbon dioxide and releasing oxygen in the process. When phytoplankton dies or is eaten by zooplankton, the carbon-rich fragments sink deeper into the ocean, where they are, in turn, eaten by other creatures or buried in sediments. This process is key to the 'biological carbon pump', an important part of the global carbon cycle.

Capturing Carbon from the Atmosphere

Scientists have long known that the ocean plays an essential role in capturing carbon from the atmosphere, but a new study from Woods Hole Oceanographic Institution (WHOI) shows that the efficiency of the ocean’s biological carbon pump has been drastically underestimated, with implications for future climate assessments.



Scientists have long known that the ocean plays an essential role in capturing carbon from the atmosphere, but a new study shows that the efficiency of the ocean’s biological carbon pump has been drastically underestimated. (Video by Elise Hugus, UnderCurrent Productions, © Woods Hole Oceanographic Institution)

In a paper published on 6 April in *Proceedings of the National Academy of Sciences*, WHOI geochemist Ken Buesseler and colleagues demonstrate that the depth of the sunlit area where photosynthesis occurs varies significantly throughout the ocean. This matters because the phytoplankton’s ability to take up carbon depends on the amount of sunlight that penetrates the ocean’s upper layer. By taking into account the depth of the euphotic – or sunlit – zone, the authors found that about twice as much carbon sinks into the ocean per year than previously estimated.

Carbon Pump

The paper relies on previous studies of the carbon pump, including the authors’ own. “If you look at the same data in a new way, you get a very different view of the ocean’s role in processing carbon, hence its role in regulating climate,” says Buesseler. “Using the new metrics, we will be able to refine the models to not just tell us how the ocean looks today, but how it will look in the future,” he adds. “Is the amount of carbon sinking in the ocean going up or down? That number affects the climate of the world we live in."

In the paper, Buesseler and his co-authors call on their fellow oceanographers to consider their data in the context of the actual boundary of the euphotic zone. "If we're going to call something a euphotic zone, we need to define that," he says. "So, we're insisting on a more formal definition so that we can compare sites."

Rather than taking measurements at fixed depths, the authors used chlorophyll sensors – indicating the presence of phytoplankton – to rapidly assess the depth of the sunlit region. They also suggest using the signature from a naturally-occurring thorium isotope to estimate the rate at which carbon particles sink.

Ocean Twilight Zone Project

Buesseler is a principal investigator with WHOI's Ocean Twilight Zone project, which focuses on the little-understood but vastly important mid-ocean region. In a commentary published in *Nature* on 31 March, Buesseler and his colleagues call on the international marine research community to intensify their studies of the twilight zone during the upcoming United Nations Decade of the Ocean (2021–2030). Increased understanding of the twilight zone ecosystem and its role in regulating climate, the authors say, will lead to global policy to protect the area from exploitation.

Co-authors of the paper include Phillip Boyd of the University of Tasmania, Australia; Erin Black of Dalhousie University, Nova Scotia, and Lamont-Doherty Earth Observatory, New York; and David Siegel, University of California, Santa Barbara. This work was funded by WHOI's Ocean Twilight Zone project; NASA as part of the EXport Processes in the global Ocean from RemoTe Sensing (EXPORTS) program; the Ocean Frontier Institute at Dalhousie University; and the Australian Research Council.

About Woods Hole Oceanographic Institution

WHOI is a private, non-profit organization on Cape Cod, Massachusetts (US), dedicated to marine research, engineering and higher education. Established in 1930 on a recommendation from the National Academy of Sciences, its primary mission is to understand the ocean and its interaction with the Earth as a whole, and to communicate a basic understanding of the ocean's role in the changing global environment. www.whoi.edu.

Caption: Marine chemist Ken Buesseler (right) deploys a sediment trap from the research vessel Roger Revelle during a 2018 expedition in the Gulf of Alaska. Buesseler's research focuses on how carbon moves through the ocean. Buesseler and co-authors of a new study found that the ocean's biological carbon pump may be twice as efficient as previously estimated, with implications for future climate assessments. (Photo by Alyson Santoro, © Woods Hole Oceanographic Institution).