The Yin and Yang of Coastal Carbon

UNH Scientists Piece Together the Gulf of Maine's Carbon Cycle Puzzle

---

Thursday, June 13, 2013

UNH carbon dioxide sentinel buoy off Appledore Island after January 2013 Nor'easter. Photo by Shawn Shellito, UNH-EOS.

Back in the spring of 2004, when the Center for Coastal Ocean Observing and Analysis (COOA) began monthly scientific cruises in the Gulf of Maine, the term "ocean acidification" had yet to enter the vernacular of climate change.

Just five years later, the Federal Ocean Acidification Research and Monitoring Act was passed and, in its wake, the National Oceanic and Atmospheric Administration established its Ocean Acidification Program in recognition that the problem of rising ocean acidity "is emerging as an urgent environmental and economic issue on our nation's east and west coasts and in many areas of the world."

Making measurements relevant to tracking ocean acidification—although not named as such—was already one part of why the COOA cruise "transects" were initiated: to better understand the complex dynamics of coastal ocean waters, most particularly the role they play in either storing or out-gassing atmospheric carbon dioxide.

"The biggest thing we were asking at the start was, 'Is the Gulf of Maine a sink or source of carbon dioxide?' At the time, no one on the East Coast knew very well what the coastal ocean was doing in this regard," says Doug Vandemark, research associate professor and director of the Ocean Process Analysis Laboratory (OPAL) within the UNH Institute for the Study of Earth, Oceans, and Space.

He adds, "And it was important to find out because, among other things, if our region's ocean is a big sink, is it large enough that we need to include it in the total ocean budget for CO2 uptake?"

What has been generally known is that continental shelf systems like the Gulf of Maine are highly productive biologically because they receive large nutrient input from both the land and adjacent ocean waters.

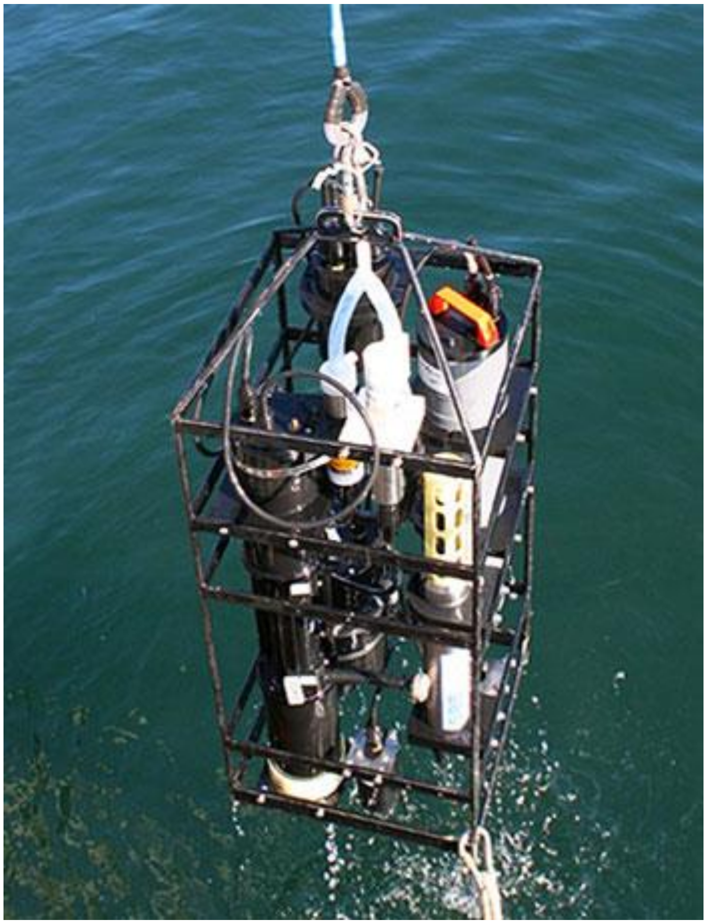
And because the annually recurring process of biological growth uses carbon dioxide, it has been suggested that these systems serve as pumps that draw the gas out of the atmosphere and sink it into the deep blue sea—an important role in the global ocean carbon cycle despite the fact that coastal systems represent just seven percent of the global ocean surface.

After gathering enough data year after year to provide a time series—measurements of sufficient length, consistency, and continuity to determine climate variability and change—COOA researchers have now shown that the Gulf of Maine is neither a clear sink nor source of carbon dioxide but, rather, a sort of recycling center for the greenhouse gas.

Says Vandemark, "Although like most coastal systems the air-sea CO2 exchange is highly variable in both time and space, we've concluded that the gulf has both a time of year when CO2 is sinking and a time when it's ejecting the gas. And in most years, the exchange turns out to be in net balance."

A Marginal Sea

One reason for this net balance is that the 69,120-square-mile body of water is a semi-enclosed basin or what's known as a marginal sea because several effective gateways, including channels around big George's Bank, limit what is exported permanently out of the system.



INSTRUMENT PACKAGE USED DURING THE COOA CRUISE "TRANSECTS" TO BETTER UNDERSTAND THE COMPLEX DYNAMICS OF COASTAL OCEAN WATERS. PHOTO BY SHAWN SHELLITO, UNH-EOS.

"While we do observe a lot of biological production, we don't have the pumping/export mechanism to flush the organic carbon out before it comes back up and is recycled," Vandemark says. "That is the most fundamental observational result from our time series data so far."

Vandemark adds that a next step in the scientific inquiry is seeking to understand how fragile this balance is over time. "This has required expanding our observations and attempting to develop models for how that balance is maintained by a mix of key processes, including seasonal temperature, wind, ocean mixing, and biological changes."

Since 2010, and with recent additional support from NOAA's Ocean Acidification office, the scientists' data collection has focused on hourly measurements at the UNH carbon dioxide buoy located northeast of Appledore Island. A recent addition to the buoy is the region's first autonomous ocean acidity measurement sensor. The complement of daily chemical, biological and physical oceanographic data recorded by this buoy will serve as the foundation for understanding the Gulf of Maine's fragile carbon balance.

"The cruise and buoy data have shown us that there is profound variability in the water temperature, salinity, and probably biology on a year-to-year basis," says OPAL oceanographer Joe Salisbury. "We can tell a lot about what's causing the variability in CO_2 by looking at how temperature and salinity change, but we aren't able to see clear trends over the nine years and we need to continue to make measurements on the scale of decades for a clearer picture to emerge."

Originally published by:
Spheres Online

- WRITTEN BY:
  Staff writer | Communications and Public Affairs

SUSTAINABILITY