Climate Change Monitoring in the Labrador Sea

The DFO (Department of Fisheries and Oceans) Climate and Tracers laboratory at the Bedford Institute of Oceanography in Dartmouth, Nova Scotia, embarks on an annual mission to sample sites located in the Labrador Sea as part of the Atlantic Zone Offshore Monitoring Program (AZOMP). These sites span northeastward from Labrador over to the southern tip of Greenland. The Labrador Sea is one of the very few places in the global ocean where deep convection takes place, providing oxygen and nutrients to the ocean's interior. Recent climate-change related shifts in the Arctic such as rapidly melting glaciers and shrinking Arctic Sea ice extent have shown to decrease the rate of this deep convection, potentially cutting off the supply of oxygen and nutrients to deeper layers and to downstream areas of the ocean.

The collection and analysis of water samples from these sites help us to report on the impacts of a changing climate and on how ocean water circulates in this important region. The rosette, a piece of sampling equipment consisting of large bottles arranged around a circular frame, is lowered down to the seabed, and slowly brought back up. Bottles are snapped shut at specific depths to collect water from precise locations that target certain water masses. Over the span of the 3-to-4-week expedition, hundreds of water samples are collected for onboard chemical analysis of chemical tracers, dissolved oxygen, and pH. Samples are also preserved onboard and taken back to the lab for analysis.

All of this information, collected by DFO researchers annually for over 30 years, represents an invaluable long-term dataset that tells us about the state of the ocean. The AZOMP monitoring program data represents a baseline against which to compare recently incorporated gases, providing key information about ocean circulation and the impacts of climate change. Onboard measurements of chemical tracers (CFCs and SF_6) allow us to calculate "ventilation" ages, the last time the water was in contact with the surface.

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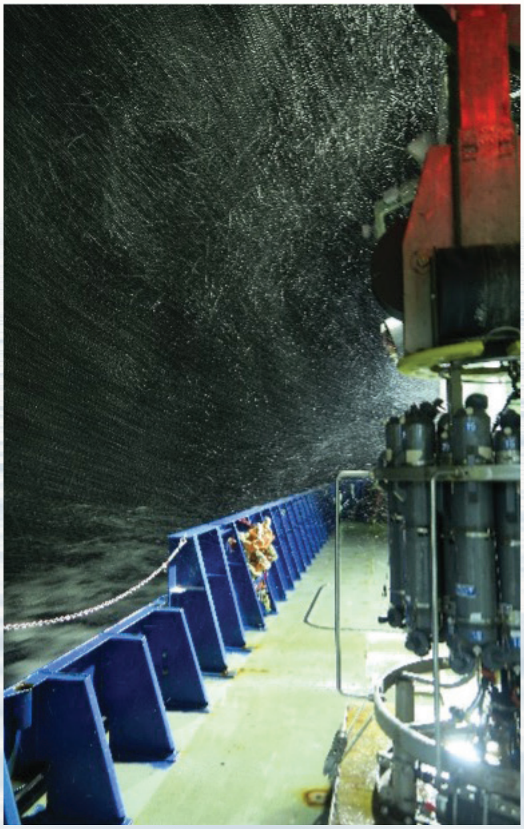
From this, we can calculate the depth of the ocean's convection and the rate of the uptake of anthropogenic CO_2. And once we are back at our lab in Dartmouth, Nova Scotia, we determine the total inorganic carbon, partial pressure of carbon dioxide and total alkalinity. Together, these variables can determine the state of the ocean with respect to ocean acidification. One third of the increasing atmospheric carbon dioxide (CO_2) emissions are taken up by the ocean's surface which makes it more acidic, decreasing its pH. Since even small declines in pH or shifts in oxygen and nutrients can have important implications for the survival of life in the ocean, this is critical and timely knowledge.

The analysis of samples on a moving ship subjected to a multitude of weather conditions is an operational challenge. Instruments sway back and forth, and equipment gets jostled and shaken; everything needs to be secured to ensure instrumentation robustness and high precision results. Although we work through most conditions, including snowstorms and high seas, occasionally it becomes too rough, and we must suspend operations until relative calm returns.



When in a remote location, days from land and in the middle of unpredictable conditions, we need to be outfitted with superior quality gear and equipment, and we must be prepared for every eventuality. Since we never know when we might need to troubleshoot or repair any part of our systems while on board, we maintain an inventory of contingencies and backups of all essential equipment. And through careful planning, we ensure our yearly mission to the Lab Sea is a success. I feel lucky to be part of such a capable, adventurous, and dedicated crew of scientist-sailors who are passionate about protecting our oceans!

Pictures submitted by Carrie-Ellen Gabriel