How Arctic Ice Affects Gas Exchange Between Air and Sea

Scientists begin to fill a major data gap by investigating carbon dioxide dynamics in a remote region of the Arctic Ocean.

Source: Journal of Geophysical Research: Oceans

The surface buoy and satellite transmitter of an ice-tethered profiler deployed in 2012 by Woods Hole Oceanographic Institution personnel as part of an ice-based o (IBO). IBOs include a suite of sophisticated water, ice, snow, and atmospheric monitoring devices. The Canadian icebreaker CCGS *Louis S. St-Laurent* is shown in t background. Credit: M. DeGrandpre, University of Montana

By Sarah Stanley 14 April 2017

Climate change is rapidly transforming the world's oceans, and researchers are scrambling to understand what that means for the physical and biogeochemical (https://eos.org/research-spotlights/uncertainty-evaluations-improve-biogeochemical-simulations) processes that govern ocean systems around the world. Scientists have measured carbon dioxide (CO_2) gas dynamics in many ocean regions to predict future CO_2 exchange between the air and sea, which will influence ocean acidification (http://www.pmel.noaa.gov/co2/story/What+is+Ocean+Acidification%3F) and global warming. Nonetheless, such data are sorely lacking for remote polar regions, where sea ice ship access.

Woods Hole and Purdue researchers auger an ice hole for deployment of equipment through the ice in 2014. Credit: C. Beatty, University of Montana

To help fill the polar data gap, *Islam et al.* (http://onlinelibrary.wiley.com/doi/10.1002/2016JC012162/full) investigated gas exchange in the waters of the Arctic Ocean's vast C Basin (https://www.jpl.nasa.gov/images/earth/20120104/earthA20120104-full.jpg). In August 2012, they deployed ice-tethered profilers (http://www.whoi.edu/page.do?pid=20756) in t regions, one with a dense cover of sea ice and another with only sparse ice. Each profiler included a bundle of sensor instruments suspended about 6 meters deep in and tethered to the ice floating above.

For almost 50 days, the sensors measured carbon dioxide and oxygen levels, temperature, salinity, and chlorophyll *a* fluorescence, which helps reveal biological pro The sites were 222 kilometers apart, on average, and as the sea ice drifted, the tethered sensors did too.

The team previously published (http://iopscience.iop.org/article/10.1088/1755-1315/35/1/012018) their gas measurements in May 2016, reporting that carbon dioxide levels at were below atmospheric saturation during the study period, whereas dissolved oxygen was slightly supersaturated. In the new study, the scientists compared the tw examine how ice cover influenced observed variability in oxygen and carbon dioxide levels. They used computational modeling to analyze sensor data in the context concurrent oceanic and atmospheric conditions.

The results suggested that in the region with sparse ice cover, biological production, gas exchange with the atmosphere, and mixing between different layers of seaw influenced oxygen and carbon dioxide variability. In the ice-dense region, mixing played a dominant role in gas variability, and biological production and gas exchar provided a negligible contribution.

These findings could help improve understanding of gas exchange in the Arctic Ocean. Arctic sea ice is declining rapidly, and some researchers predict that fresh me will inhibit nutrient transport and limit biological activity, allowing the surface ocean to come into equilibrium with atmospheric CO_2 and promoting acidification. T authors say that continued CO_2 monitoring in the Canada Basin is necessary to better understand current trends and future possibilities. (*Journal of Geophysical R Oceans*, https://doi.org/10.1002/2016JC012162 (https://doi.org/10.1002/2016JC012162), 2017)

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