Braving the Elements

When scientists battle ice and wind, sometimes Mother Nature wins

In the spring, regions of polar ice melt are where the action is, chemically-speaking. That's why chemists Rachel Stanley and Brice Loose nearly risked life and limb to study one of them in 2011.

Polar ice zones are important regions for the transport of carbon dioxide (CO_2) from the atmosphere to the sea. The advance and retreat of polar ice modulates this exchange. During the winter, sea ice acts as a barrier to air-sea gas exchange. In the spring, when the ice melts, biological production thrives as light and nutrients become plentiful. As the ice melt season lengthens, scientists like Stanley and Loose are eager to measure the impact of ice on CO_2 cycles, but it isn't easy.

With funding from the Arctic Research Initiative, Stanley and Loose set out to develop a new methodology for simultaneously quantifying biological production and air-sea gas exchange in melting ice zones. They proposed a pilot study in the Bras D'Or Lakes, Nova Scotia—an analog to the Arctic environment that they hoped would provide an ideal natural laboratory for studying ice melting processes in an accessible field environment.

"The boat is the biggest challenge," Stanley explained, adding that the craft has to be agile enough to navigate tight channels in ice-chocked waters. "We're also using a mass spectrometer and a

gas chromatograph, which are generally launched from larger ships, so those instruments had to be modified for this deployment."

The Bras d'Or expedition proved to be a perfect illustration of just how challenging it can be to work in extreme environments.

After waiting weeks for the first signs of thawing, Stanley and Brice received the call from Dr. Bruce Hatcher of Cape Breton University to tell them that the ice was starting to melt. The pair rushed to Nova Scotia, only to be met by a cold snap. It persisted for eight days. They tried a few reconnaissance missions in the dive boat they had hired, but found that the ice was too thick for them to take good measurements. When the ice finally started to melt, the wind kicked up.

"Ice is manageable," Loose said. "Ice and wind is not manageable."

Day One of ice and wind wasn't ideal, but the team was able to take some measurements. Day Two was a different story. Just as they located a "sweet spot" for taking measurements, the wind shifted, and ice started to blow back against the ship, causing it to drift onto a sandbar. The boat stopped drifting, but the ice did not. With the boat in frigid waters and listing at more than 45 degrees, Stanley and Loose had to retrieve and secure their instruments, back up their data onto laptops, evacuate to a dinghy, and row to shore amid the ice floes —quickly.

In three days, the storm had passed and the team was able to retrieve their equipment from the damaged boat. By then, the ice—and the opportunity for taking good measurements—had melted away.

The team has been thinking about what they could have done differently. "When we do this work in the Arctic, we're supported by a logistics team," Loose said. "We never have to think about things like our own safety.

"We've both asked for immersion suits for Christmas," Stanley added.

One thing they will do differently next time—OCCI granted the team an additional $48,500 to attempt the fieldwork in spring 2012—is use a smaller boat, one that quickly can be hauled out of the water and onto a trailer. Perhaps the most interesting lesson learned was that although Stanley and Loose sought out Bras d'Or, Nova Scotia, as a proxy environment for the Arctic, they found fascinating climate issues right where they were.

"The fisheries in this area have experienced dramatic changes as the rate and timing of ice melt changes each year," Loose said. "Huge climate impacts have changed people's lives, and we rarely hear about it. Research like ours, we hope, will help us better understand both the Arctic and places like Bras d'Or."

Rachel Stanley and Brice Loose were awarded $192,056 in Arctic Research Initiative funds for "Controls on CO_2 Fluxes in the Marginal Ice Zone: Biological Productivity and Air-Sea Gas Exchange."