ICE: Watching it Melt

Jamie Holte '99 Researches Greenland's Melting Glaciers and Their Impact on the Arctic and All of Us

RV Adolf Jensen, a ship the Scripps Institution of Oceanography has frequently used in Sermilik Fjord, during a research cruise in 2021. Photo by Jamie Holte.

We had stopped in Tiilerilaaq, a small village in Southeast Greenland, because Max Audibert, headmaster of the village's school of twelve or so students, had asked us to collect some seaweed and sediment samples from a small channel nearby. Tiilerilaaq is perched on the edge of Sermilik Fjord at the intersection of multiple glacially-carved U valleys. At the head of the fjord, Helheim Glacier, a slow-moving river of ice that ends in the ocean, calves icebergs the size of skyscrapers that float past the town.

We had met Max during an oceanographic research cruise to Sermilik Fjord in 2021. I'm part of a lab at Scripps Institution of Oceanography in San Diego that studies the physics of high-latitude oceans, including Greenland's fjords. Our lab is trying to document and understand the rapid changes occurring in the Arctic, as well as the ramifications of these changes for the globe and for local communities in Greenland.

We do this by going on cruises to collect basic ocean measurements. From a ship, we lower instruments into the ocean that measure temperature, salinity, and currents. We also collect water samples from various depths; some colleagues will analyze these for nutrients. Others might measure the noble gas concentrations. Still others will peer into microscopes to categorize the zooplankton, tiny animals that drift around in the water. We do this in one spot, then the ship moves on to another spot and we do it again. And again. Sometimes we work in shifts, collecting observations for twenty-four hours a day for two to five weeks.

The camaraderie and shared science goals make the hard work of cruises fun and exciting. The gorgeous surroundings don't hurt, either. We bask in alpine-glow sunsets that last for ages; if we stay up late enough, we can sometimes see the Northern Lights. This past summer we spotted Fin, Sperm, Pilot, and Humpback whales, as well as numerous seals. In still moments, we can hear an ever-present crinkling sound. It is the sound of thousand-year-old air bubbles, trapped in the ice sheet long ago, gently popping into the ocean as icebergs melt.

We deploy moorings that will record observations for two years until we come back to recover them. Moorings are clusters of instruments anchored to the seafloor. In the fjord, the short moorings are tucked near the bottom to avoid icebergs going by overhead; these icebergs extend hundreds of meters below the surface, and not infrequently sweep away our instruments. When we come back, we use acoustic signals to tell the moorings to (hopefully) release from their anchors and float to the surface with their data. Sometimes we use helicopters to deploy instruments in the melange, a traffic jam of icebergs near the glacier that is impenetrable to ships.

Data in hand, we see a cold, fresh layer near the surface in the fjord. This is a mix of water from the Arctic and meltwater from Greenland. It sits above warmer, saltier water from the Atlantic Ocean. This warm Atlantic water weaves into the fjord at depth, carrying heat and nutrients into the fjord all the way to Helheim Glacier. The heat helps erode Helheim's calving face, an ice cliff stretching more than one hundred meters into the air and also extending six hundred meters underwater to the seafloor.

On the cruise last summer, the Greenlandic crew carefully navigated us into Midgaard Fjord, a northerly branch of Sermilik Fjord that we had never reached before. Over the last fifty years Midgaard Glacier has retreated miles up the fjord. As Midgaard Glacier thinned and retreated, it left behind a swath of barren ground, a trimline, that rose high above our ship as we moved deeper into the fjord. It was a striking reminder of how quickly climate change can alter a region.

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Jamie Holte, Researcher

RV Tarajoq in Midgaard Fjord in 2023. The trimline left behind by the glacier is visible on the mountains behind the ship. Photo by Alex Rivest.

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- Jamie Holte

RV Tarajoq in Midgaard Fjord in 2023. Photo by Alex Rivest.

Greenland has hundreds of tidewater glaciers like Helheim and Midgaard. Our lab's observations help scientists understand the ocean's contribution to the melting and retreat of these glaciers. If warming continues unabated, we can expect Greenland to contribute almost two feet to global sea level rise by 2100.

Besides raising sea levels, freshwater from Greenland also has the potential to impact large-scale circulation patterns in the global ocean, in particular the Atlantic Meridional Overturning Circulation. This complicated system of currents is, in essence, a global-scale loop of warm water flowing north at the surface and cold water flowing south at depth. The overturning portion of this system, where the warm waters gain density and sink to create the southern loop, occurs in the North Atlantic. Excessive freshwater from Greenland could disrupt this crucial section.

Many residents of Tiilerilaaq survive via subsistence hunting. Their traditional ecological knowledge of the diverse ecosystem supported by the fjord has allowed them to thrive for generations. However, the fish species found in the fjord are changing, as are the patterns of whales and other animals that inhabit the fjord. Warmer winters

Jamie and Chris Basque, a mooring technician, assemble and label a mooring before deployment. Photo by Alex Rivest.

have meant a reduction in winter sea ice, so fewer families maintain sled dog teams, their traditional means of hunting in winter. Environmental change, however, is only one of the forces altering life in Greenland; tourism, mining, international politics, and technology have exploded in Greenland, potentially disrupting life more than climate change.

Max told us that in especially lean periods, the seaweed is the community's food of last resort. He was worried that it was being contaminated by oil pollutants from the many small boats in town. Perhaps in an unsettled climate, this backup food resource will be even more important.

We hope that our research can help humanity, as well as the residents of Tiilerilaaq, anticipate future changes.

— Jamie Holte, Class of 1999

Tiilerilaaq, a village in Southeast Greenland. Photo by Jamie Holte.