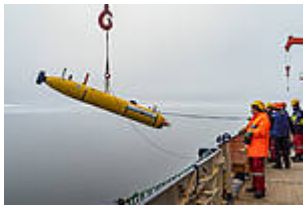
ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

Expedition

Exploring Greenland's 79 North Glacier

Research vessel Polarstern returns from the Arctic

[12. October 2017] **Following a five-month journey, the research vessel Polarstern returned to its homeport in Bremerhaven on the evening of Friday, 13 October. During the most recent expedition, the vessel reached the 79 North Glacier in Northeast Greenland, where the researchers on board investigated how the ocean temperature, which has been rising over the past twenty years, has affected the glacier's mass.**


Over the past several weeks, the 45 researchers on board the research vessel Polarstern have been investigating a unique subject: the 79 North Glacier in Northeast Greenland. Together with its neighbouring glacier Zachariæ Isstrøm, it transports ice from the Northeast Greenland Ice Stream – which covers an area equivalent to roughly 16 percent of the Greenland Ice Sheet – to the sea. The 79 North Glacier exhibits an 80-kilometre-long floating ice tongue – similar to the ice shelves found in the Antarctic. The cavity below the tongue is filled by seawater.


Glacier (Greenland) (Photo: Christian R. Rohleder)

Long-term studies conducted at the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI) have revealed that the Atlantic Water in Fram Strait (at the transition between the Nordic Seas and the Arctic Ocean) has risen by roughly one degree Celsius over the past twenty years. In addition, the data shows that this subsurface warming has also spread across the continental shelf of Northeast Greenland's toward the 79 North Glacier. Warm water can melt glaciers from below. Zachariæ Isstrøm lost its ice tongue a few years ago, and the AWI researchers now want to use sea- and land-based measurements to determine whether the 79 North Glacier might face a similar fate. That could certainly happen in the future, since warmer surrounding water would accelerate melting. However, dynamic effects (altered ice flow speeds) can also impact the thickness of the glacier. Accordingly, the goal of the scientists is to arrive at a

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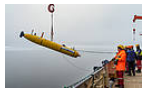
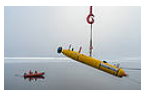





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better grasp of the underlying mechanisms at work.


Mooring work (Photo: Christian R. Rohleder)

"By taking measurements in the area right in front of the cavity, where warm Atlantic water flows in and colder water flows out, our goal is to monitor the strength of this circulation, and to determine how much heat from the Atlantic water is made available for melting the glacier tongue within the cavity," explains Prof Torsten Kanzow, an AWI oceanographer and chief scientist of the expedition. To do so, last year he and his team had installed moorings equipped with sensors, both directly in front of the glacier cavity and at other key sites of the circulation of Atlantic water on the continental shelf of Greenland. By pursuing this approach, the researchers hope to trace the circulation of this watermass from Fram Strait to the coast of Northeast Greenland and toward the 79 North Glacier, to determine how variable the circulation is and to infer what the physical causes of the fluctuations are.

"Based on our data, we can now show that warm Atlantic water has been flowing into the glacier cavity continuously since last summer," says Kanzow. That being said, the flow hasn't been constant, but has waxed and waned. As the oceanographer explains: "For example, we're not sure why the inflow suddenly increased at the end of 2016, but we expect that it was likely due to some factor outside the cavity." The oceanographers also found periods marked by unusually warm Atlantic water inflow in the cental part of the continental shelf. "We can't say yet, how much of this water actually made its way into the glacier cavity – we'll conduct the corresponding computer-based analyses back in Bremerhaven," adds Kanzow.


AUV (Photo: Christian R. Rohleder)

To take a closer look at the important small-scale circulation processes near the glacier calving front, the team also relied on AWI's autonomous underwater vehicle (AUV) operated by Deep-Sea Ecology and Technology Group. Thanks to its manoeuvrability, it is ideally suited to taking oceanographic readings at the calving front, which is characterised by a steep and complex seafloor topography. The AUV can follow a pre-programmed course at high precision and provide data on the intense small-scale mixing of the turbulent flows into and out of the cavity, which takes place directly in front of the calving front.

Early this summer, AWI glaciologists began investigating the glacier intensively, flying by helicopter to 50 different stations and conducting on-site radar measurements of its ice tongue. They also set up four new autonomous stations

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The Institute

The Alfred Wegener Institute pursues research in the polar regions and the oceans of mid and high latitudes. As one of the 19 centres of the Helmholtz Association it coordinates polar research in Germany and provides ships like the research icebreaker Polarstern and stations for the international scientific community.

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that will transmit data over an extended period. In the course of the latest Polarstern expedition, several of the stations were checked with the help of the ship's on-board helicopter. A second trip to the measuring stations is slated for 2018. Once the radar measurements from the two years are compared, it will be possible to calculate the ice tongue's melting rate. The AWI glaciologists will then combine these direct measurements with satellite data, so as to determine how important the melting on the glacier's underside is for Greenland's loss of mass.


RV Polarstern (Photo: Stefanie Arndt)

Torsten Kanzow recalls one of the expedition's highlights: "We were on the edge of our seats during one of the AUV dives near the glacier. It encountered densely packed ice when it was finally resurfacing, and it was only owing to the crew's skill that we managed to safely retrieve it." And that wasn't the only memorable aspect. Comparing the conditions this time around with his last expedition toward the coast of Greenland, which was in August 2016, he adds, "This September we could clearly feel the coming winter. The massive amount of newly formed ice off the coast made our work much harder: any equipment that came into contact with the seawater was immediately coated in ice. It was also a bit dicey recovering the moorings while surrounded by dense ice and heavy fog, which once again shows how much our success depended on the outstanding skill and experience of the crew of Polarstern."

Polarstern left her homeport for this year's Arctic season on 24 May 2017. The first four segments of its journey chiefly took the research vessel to different parts of the Svalbard archipelago, before the final expedition took her to northeast Greenland. The ship will remain at the Lloyd Werft shipyards in Bremerhaven until shortly before Christmas. During this time she'll be fitted with a new generator and be treated to a fresh underwater coating before she departs again, on a course to the Antarctic.

Video

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