# Change of shifts at the north pole

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The Russian icebreaker Kapitan Dranitsyn is reaching the German icebreaker Polarstern. Credit: Alfred-Wegener-Institut/Esther Horvath, CC-BY 4.0

After exchanging research teams and crewmembers, the greatest expedition to the Central Arctic of all time is now entering the next phase, during which urgently needed research into the Arctic climate system will be conducted. In the following paragraphs, the team from the

first leg of the journey, which was dominated by thin sea ice, review the mission so far: despite extremely challenging conditions, they maintained a steady flow of scientific data. The new team will now face the darkest and coldest research phase: the Arctic winter, which has never been researched before.

This week, surrounded by the Polar Night, the participants in the MOSAiC expedition are engaged in a logistically challenging shift change: roughly 100 people are trading places between the German research icebreaker Polarstern, which has been drifting with the Arctic sea ice since October, and the Russian resupply icebreaker Kapitan Dranitsyn. After a one-week delay in its departure due to a cyclone in the Barents Sea, it took the ship ten days, characterised by increasingly difficult ice conditions, to make its way to the Polarstern. While the participants from the first phase are now homeward bound, the darkest and coldest phase of the MOSAiC expedition awaits the new team.

In the course of the past several weeks, the international team from the first leg installed a complex research infrastructure on the Arctic ice. On the MOSAiC ice floe, currently located at 86°34' North and 119° East, 270 kilometres from the North Pole, the 'ice camp' was erected around the trapped icebreaker Polarstern: a research station designed for the various focus areas of the MOSAiC expedition. The ship and its ice camp have already drifted with the Arctic ice ca. 200 kilometres toward the North Pole—accompanied by an extensive network of monitoring stations, which were deployed in a 40-kilometre radius around the Polarstern by the Russian Arctic and Antarctic Research Institute (AARI) icebreaker Akademik Fedorov during the first few weeks of the mission.

"The first phase of the expedition wasn't easy," reports MOSAiC expedition leader Prof Markus Rex from the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI). "The ice, at

less than a metre, is unusually thin, highly dynamic and constantly in motion. We very often saw new cracks and channels in the ice, or the formation of several-metre-tall pack ice hummocks: jagged piles of ice, formed when rising pressures cause the ice floes to press against one another and stack up. The force of this crashing ice impressively demonstrates the power of nature, in whose hands we now find ourselves. In addition, newly formed hummocks often buried our equipment, which we then had to retrieve and set up all over again—not to mention the cracks in the ice, which are dangerous for the team and instruments alike."

To make matters worse, a storm with wind speeds of up to 100 km/h, which struck the expedition in mid-November, shifted the various parts of the ice camp by hundreds of metres. Several power cables were torn in the process, which meant many of the instruments on the ice had to be powered with emergency generators—plus the 30-metre-tall monitoring tower fell over. In the meantime, the damage has been repaired. "We did a good job of adapting to this ice dynamic, which allowed us to continue gathering the urgently needed data from this region virtually uninterrupted. We're leaving behind a flexible and modular research camp where everything is recording and working smoothly," claims MOSAiC expedition leader Rex, who will once again lead the expedition on site from early April.

From a scientific standpoint, the storm was one of the highlights of the expedition so far. Directly confronted with this important element of the Arctic climate system, the MOSAiC experts were given an outstanding opportunity to investigate the influences of Arctic storms first-hand: on the water column in the ocean, and on the ice, snow and atmosphere. "Never before have the effects of these storms on the Arctic climate system been so comprehensively recorded," says Rex.

Now that the baton has been passed to them, the members of the

recently arrived team for the second phase of MOSAiC expect to see both challenges and scientific highlights. "We'll most likely see further ice deformations," says Prof Christian Haas, a sea-ice geophysicist at the Alfred Wegener Institute and leader for the second leg of the expedition. "How rising pressures exerted on the ice lead to increased thickness and the formation of massive pack ice hummocks is one of the questions we'll be investigating. I'm especially curious to see if there will continue to be warm air intrusions in the Central Arctic, which we've monitored in December and January in previous years, and whether they might even produce rain at the North Pole in winter. In this context, too, direct observations on location would be extremely valuable," says Haas.

During e.g. the five-day handover process on site, the new team will receive intensive training on the established working and safety concepts—including those for polar bears, which had repeatedly visited the research camp. "A major challenge for us 'newbies' is the fact that we're now on an ice floe that we've never seen by the light of day, and as a result, we have no idea where we actually are," says Haas, describing the highly unusual nature of the second phase, the only one that will take place completely during the Polar Night: unlike their predecessors, the members of the new team never had the chance to view their surroundings in daylight. "So we have to learn how to perceive our surroundings using means other than our eyes," says the polar researcher. In this regard, the team can fall back on e.g. helicopters equipped with laser scanners and infrared cameras, which fly over the ice in low passes to map it in detail.

The transfer between the two ships represents a complex logistical operation, during which some cargo will be moved from ship to ship over the ice, and other cargo will be moved directly, by crane. One particularly tricky task: transferring temperature-sensitive pieces of cargo, which can't be allowed to freeze, at outside temperatures of nearly minus 30 degrees Celsius. "But we also have a number of Christmas

presents with us," says Haas, whose time as expedition leader will include celebrating a number of international holidays in the Arctic ice. At the same time, as Markus Rex relates, the participants from the first leg are already looking forward to seeing their families and friends again—not to mention sunlight. "The mood here is excellent. Nevertheless, some of the participants are reluctant to hand over the instruments—their 'babies' on the ice—to the next team."

Provided by Alfred Wegener Institute