

BREATHE Field School – A Teaching Cruise to the Arctic

The BREATHE field school is a teaching cruise organized through the two research projects BREATHE (Bottom-sea ice Respiration and nutrient Exchanges Assessed for THE Arctic) and SIDRIFT (Sea Ice Deformation and Snow for an Arctic in Transition). The goal is to bring early career scientists to the Arctic to learn about ice field work and get some hands-on experience. The scientific team 2023 consists of 21 participants and 8 instructors from all over the world with various backgrounds including physics, microbiology, biogeochemistry, biology, satellite image analysis and oceanography. The field school takes place on board of the research vessel Kronsprins Haakon (KPH) belonging to the Norwegian Polar Institute (NPI).

09.-10. May 2023 – Meet-up in Tromsø

After several online meetings and weeks of preparation the whole research team meets up first time in person on May 9th in Tromsø. Visiting students can use the lab facilities to prepare chemicals needed for their fieldwork during the cruise. The welcome lecture at UiT is followed by a social gathering at a lavvo (fireplace and hut) in Tromsdalen for some hot dogs and networking.

On Wednesday the team learns about Norwegian Sami culture in a short lecture before starting floatation suite training in several rounds. This is conducted at NPI and includes a short safety briefing on the correct behaviour in case of falling through the ice, followed by a real floatation training in the harbour water.



Social gathering in Tromsø at the lavvo. Picture by Nicolas Michalezyk

11.-15. May 2023 – Transit from Tromsø to the ice

The big day is here! All participants of the cruise are arriving in Breivika harbour in the morning to board KPH! Equipment gets loaded, cabins assigned, and passports checked. After a safety introduction by the ship's crew, we are ready to go and just wait for the ship to start moving. The vessel is quite

luxurious with a nice big dining and chillout area with big windows. Food is served three times a day and it is good! There is no fear of starving as snacks and leftovers are out all day.

Finally, the ship leaves Tromsø and goes around the island heading to Ramfjord where we are loading fuel for 10h. The transit to the ice starts on 12th of May at 04:05 in the morning. As we get up for breakfast the last islands of Norway float past our windows. For the next days, the only thing we see is water with smaller and bigger waves. During the transit every member of the scientific crew gives a short introduction about their selves and their work. We are a very diverse group with people from different backgrounds and various expertise. The instructors are giving us lectures about different aspects of Arctic sea ice. We learn about the physical properties and development of the ice itself, the algal communities living within and on the bottom of the ice as well as the bigger oceanographic features like currents which influence the whole Arctic Ocean.



We are passing Svalbard. The air gets noticeably cooler. Picture by Nicolas Michalezyk

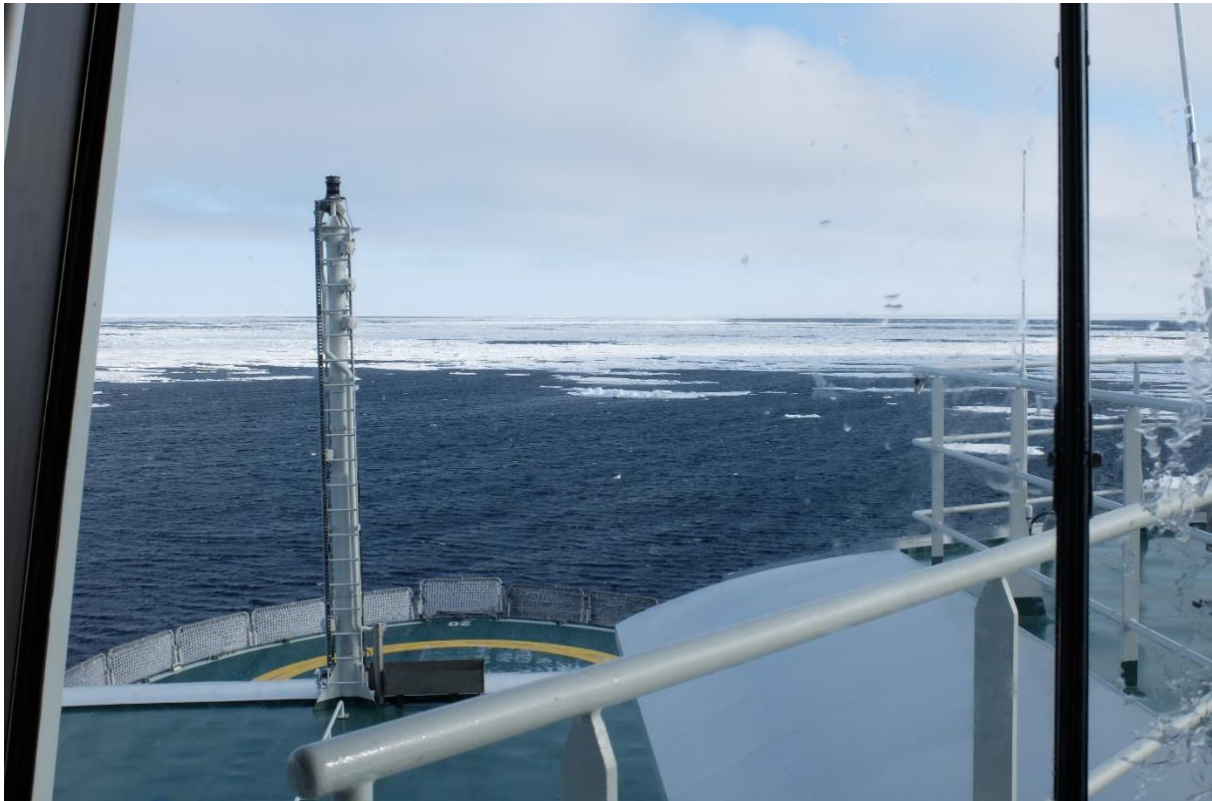
Our lectures get a little disrupted as we hit a storm causing up to 5 m high waves on 12th of May. Walking through the ship without banging into walls start to get difficult, stuff in the cabins start to slide around and even sleeping is difficult as one gets thrown back and forth in the bed. Only 5 of our 30 people team are spared from sea sickness and the general mood experiences a bump. The storm ends a day before we reach the ice, and everybody slowly recovers from this rough experience. It could have been way worse we learn afterwards. The KPH has an advanced balancing system with water tanks which help to equalize the ships movement in a storm, making our vessel quite steady in storms. Well, most of us did not really feel anything was steady...



Big waves during the storm. Picture by Nicolas Michalezyk

15. – 17. May 2023 – Ice breaking and finding a floe

On the 15th we finally hit the ice, the shaking stops and everybody is back on their feet. Now we experience a cacophony of shrieking, bursting, and crashing as our icebreaker makes its way through the ice. We are not shaking left and right anymore but jerking back and forth instead. People with cabins in front of the ship are going halfway crazy from the noise in the night, but we all make it through. As we are getting closer to field work the students receive an ice safety briefing from our safety officer to make sure everybody knows how to act on the ice, what to do during bear guard and how to react in case of emergency.



Ice ahead! Now it gets exciting. Picture by Marja Gächter.

The ice is thicker than expected and the snow on top of it makes it harder for the KPH to break the ice. We are making slow progress and the hopes of reaching 82°N are slowly fading, especially after the ship ends up doing a loop during the night and we wake up at the same spot as we went to sleep. Nevertheless, we start preparing for the field work. Instructors show the students around the labs and give a general overview for the upcoming sampling days. We have three cycles each consisting of three days planned. So far so good, now we are just missing a floe.

On 17th of May, the Norwegian national day, we finally settle for a floe. The ship gets secured to the floe and instructors go off board to deploy some equipment which will be used to track oceanographic parameters of the floe throughout our stay. Three students at a time are present on the bridge for bear watch, scanning the surroundings with binoculars for any signs of polar bears. Of course, everybody wants to see a bear but nobody wants the bears close to the ship during ongoing ice work. While instructors are busy on the ice all day the students take advantage of a free day to chill, socialize and getting ready for the sampling days to come. In the evening it gets exciting as everybody (scientists and ship crew) is allowed on the ice for the 17th of May parade in honour of the Norwegian national day. We take a little walk on the ice, swing flags and drink non-alcoholic champagne on the ice. Part of the students have practiced the Norwegian national song and perform it on the ice. Being on the ice for the first time is for many people already quite an experience. But the day just gets better as a polar bear with two cubs is spotted around 10 in the evening. The excitement following that discovery is hardly needed to be mentioned as most of the students rush to the bridge to see the bear, waking up some of the people already sleeping while doing so... We are very lucky to see the bear now as nobody is on the ice, and everybody can experience how a bear looks in real life without further stress. It is truly rather yellow than white and could totally be mistaken for a block of ice with a high concentration of algae on it.



Happy Norwegian national day! Scientists, Crew and KPH.

Cycle 1 (18. – 20. May 2023) – The work starts

Everybody is excited! Finally, the ice work can start! The first teams head out on the ice to analyse snow and ice, collect ice cores or water samples from under the ice. Some of the students look at the bottom of our floe using a remotely operated vehicle (ROV) with an installed camera. The afternoon gets interrupted as the mother bear from yesterday is spotted again near the floe. She stays far away though but close enough for us having to wrap up the afternoon and leaving the ice early. After the first day we have already a first impression of our own floe. As the ice thickness is between 1.5 and 2 m we conclude the ice actually being second year ice. We may not have made it as far north as we wanted but sitting on multiyear ice partly makes up for that. Although we start thinking about the effort it will take to drill through almost 2 m of ice every time to take a core... The positive thing is that our ice safety officer has a chill job now and we do not have to worry about students breaking through the ice.



Coring and water sampling on the ice. Pictures by Nicolas Michalezyk.

The next following days are filled with all kinds of sampling: We collect ice and water from different sites and different depths, do more measurements on ice thickness and characterization of the snow. On our first big coring day we collect 25 cores (yes, 25 and yes 25 times we need extensions on our drills...), partly for individual student projects and partly for the BREATHE project for which we only collect the bottom 5 cm of the individual ice cores. Two groups are on ice, most of the students are coring for the first time. With three drills in use the situation escalates fast into chaos. Luckily one of the students takes the lead, organizes the chaos and we manage to collect all the cores. In the evenings we meet up as a whole group to do a wrap up of the day, discuss the schedule for the next day and share findings from the day. Sometimes some of the students have something really funny to show and we receive the first field school meme report from our French meme-boy. This is brilliantly done, and all our bellies hurt afterwards from the laughing. Every evening our weather and navigation man gives us an update on the weather and the direction our floe has drifted to. The plan was to find a floe and drift back south with it. Currently, we are drifting north and slightly east. Additionally, the weather promises to be just slightly below zero degrees. These warm temperatures are causing us some headaches and we hope that the floe will not just melt away under our feet.

Last day of the cycle is heavily lab based and the students learn how to process the collected samples. A little bit of confusion and chaos evolves as the instructors try to coordinate and watch over all the students trying to keep up with the lab work. But in the end, we always manage to measure all the samples and write down the results. At least somewhere, let's deal with that problem later. Welcome to field school data chaos! The KPH is equipped with a rosette which can collect water from different depth and measures conductivity, salinity, temperature and pressure at the same time (a so called CTD). Our instructors have something quite fun planned using the fact that the pressure is increasing with depth. Styrofoam cups placed within the closed rosette water sampling bottles will shrink deep down in the ocean as the air is pressed out of them. You can imagine the students excitement as cups

and colourful pens are handed around. Everybody gets creative and design a cup to take home as a souvenir. The question arises if the cups would shrink even more if send down a second time into even deeper waters...

Cycle 2 (21. – 23. May 2023) – Drifting east

Time for sampling cycle 2. We know what to do and are getting quite efficient with our work. The field work itself starts to get done quite efficiently as we all know the drill by now. We still occasionally forget some small essentials on the ship but all in all we are rocking this! Day 1 starts off with being quite windy but luckily (or unluckily) it is quite warm, and the ice starts to get softer. Drilling cores becomes challenging, and we partly encounter water under the snow. Additionally, our plan with drifting south is not working out as our floe decides to drift east instead. Not exactly what we planned, but well, it is what it is. Day 2 of this second sampling cycle gives us some excitement. Half of the students and most of the instructors are on the ice as we all of a sudden realize that our home base is moving. Yes, KPH is leaving the floe without us! The ice team calmly informs the bridge and all of a sudden, the crew has a lot to do: Safe the gangway! Engines on full power! Get the ice anchors in! The ice team takes it easy and just waves and laughs at the leaving ship. Our cruise leader is all hard-core scientist as she commands us to 'get back to coring!' after a quick assessment of the situation. Yes, ma'am! Getting KPH back in place only takes 10 min and the situation is resolved quickly. A big applause to our bear guard squat on the bridge as they firmly continue their important task despite the momentary chaos. By the end of the day, we have all the samples taken and another story to share.



Goofing around on the ice. Science does not always have to be serious. Pictures by Alina Spera.

Cycle 3 (24.-27. May 2023) – Storms and bears

Already cycle 3! Time runs fast! This cycle is special. Day 1 goes as normal although we can feel the influence of the warm weather. Everything is soft and slushy and the bottom of the ice looks less colourful than the days before. Additionally, our floe decides to drift back west as can be seen from our position data. Looks like we are doing a loop? Day 2 comes with a huge weather change: Wind up to 80 km/h and blowing snow prevents any further ice work. Naturally, the students are disappointed

as they have to stay inside. We still got some things to do as water samples are taken with the rosette need to be processed. One good thing about the weather is that nobody misses out on cake time. Well, expect the instructors as they spend all day on the ice recovering instruments. Bear guards are in place as usual and need to concentrate quite hard as visibility is not great. Since there are no students on ice our two cruise leaders take advantage of a short good-weather window to visit a close by lead along which several clearly yellow blocks of ice were localized earlier. Good thing our cruise leader is wearing a flotation suit since we wouldn't put it past her to jump right into the water in order to collect some algae. Luckily our safety officer keeps an eye on her. As the storm rages on the next day and there is time to kill some of the students organize a King Neptun baptism event. This is a tradition on ships once 80 °N is crossed and the high Arctic is entered. The ship gets a visit from King Neptun who baptises those who dare rewarding them with safe passage and good weather. Obviously, we are all hooked and willing to get baptised. This is a secret ceremony and not too much information shall be spread but this much can be said: We faced icy waters and snow and stood before the king and queen of the high Arctic. All those who dared to be baptised are rewarded with not only honour and safe passage but also receive a diploma as proof of their courage. Maybe we did really please the spirits of the high Arctic as the following day is all sunny and wind still. This means we still get one last day on ice! As our floe drifted with quite some speed towards Svalbard during the storm the captain decides to leave the floe a day later, giving us more time to wrap things up.



Bear guarding on the bridge. Picture by Emma Forss.

Before the last day we got a special task to handle: Our oceanographic has planned some special measurements which requires sample taking every 4 h also during the night. Helpers on ice and bear guards are scheduled and some of us get the experience to work at 3 a.m. for the sake of science!

The last day on ice is amazing! The weather is great, the mood good and the work is flowing. We get a little alarmed though as the bridge informs us about a potential bear sighting. As long as nothing is confirmed we keep working and our bear guards are being extra cautious. A little later we get the

confirmation: It is indeed a mother bear with two cubs. Yet the distance is large enough and a retreat from the ice is not necessary. After lunch the other teams go on ice to take last samples and get some last training. The bear with the cubs is still visible but far away. During the first shift a second bear closer to the ship is spotted, another mother bear with one cub. The excitement on the bridge increases as suddenly two additional people are required for bear watch. It takes some logistic effort to coordinate the people on ship but in the end we manage and the ice team can continue working. Then the day is over, and we are done! Well, the field work part is done. We still need to pack the equipment, clean the labs, compile the data...



It is a privilege to see polar bears in their natural environment. Picture by Nicolas Michalezyk.

27. – 30. May 2023 – Transit to Loneyearbyen

KPH leaves our ice floe on the evening of 27th of May. We are all a little sad as we wave goodbye. But there is no time to fall into melancholy since we all have a lot to do. There are some last samples to be analysed, lab equipment to be stored away and data reports to be finished. Additionally, the students work on different outreach projects which are presented during the transit. These range from more serious and educational to funky and funny. While writing the data reports everybody gets demonstrated again how important accurate documentation of the field notes is. Mentioned the kind of chaos before it is no surprise that we end up running between different groups asking 'hey, where did you write this down? Did your group do this?'. In the end all data is found and summarized in various excel sheets. Students present some preliminary results during the two days of transit to Loneyearbyen. It is very nice to see how everything comes together. Now we realize how much work we have done: We have analysed the physical properties of the snow and ice on spot and on a wider spatial range, measured chlorophyll concentrations through the ice column, at the water-ice interface and in the water below the ice. We have collected oceanographic data right below our ice floe and all the way down to the bottom of the ocean. It is a lot, and some things still need to be analysed once

we are back home. One thing we can see already is the influence of the warm weather and the start of the melt season in the cycle 3 results.



Transit to Svalbard with a beautiful light. Picture by Marja Gächter.

The transit out of the ice is rather fast and easy as the ice is thinner as on the way in. Svalbard is already visible by eye at the horizon. The ship follows an open lead out of the ice, and we see another mother bear with a cub. Maybe even the same we saw earlier during the day. KPH breaks the ice with ease, and we cross the marginal ice zone during the night. As we wake up the ice is gone, and the sun is shining. It feels weird. Like waking up in another world. Since we have some extra time, the ship takes a detour to Kongsfjord where we cast another CTD to get some additional data. The views in the fjord are quite amazing: Glaciers ending in the ocean, pointy mountains (the seven sisters) and some of us are lucky enough to spot some whales. KPH stops another two times on the way to Longyearbyen to cast another two CTDs. While the ship takes the last measurements, we are busy cleaning the labs. Especially the floors are dirty from all the salt water we have brought in. A great job is done, and the labs are cleaner in the end compared to as when we boarded. We reach our docking station already on the evening of the 29th May. Mixed feelings arise regarding seeing land this close again. In a way it is nice, but on the other hand it feels unnatural after the last three weeks on the ship. Everything is done: Reports are finished, data is entered, cleaning is done and we are almost all packed. During our last meeting we discuss some logistics for the leaving day and get attendance diplomas handed out. And now we have time to go for a real beer in town! Looks like the morning will be tough for some people... Cabins need to be emptied by 8 a.m. and some last cleaning to be done the next morning. After this our group starts to disintegrate. Some fly home the same day, some stay in Longyearbyen for some time. Many goodbyes are said, and promises made to stay in contact. Slowly splitting up into smaller and smaller groups makes the end of the cruise feel less abrupt. Some of us enjoy the village for a few days, doing some sightseeing, shopping and just relaxing. It feels nice to have a more mellow transition back to the busy civilisation.

All in all, the cruise was quite a success! We learned so much, had awesome experiences, found new friends and expanded our professional networks. Everybody will take something home from this journey. Not only data and scientific knowledge but also memories to feed on in rougher times.



The scientists team in front of KPH. Thank you for an awesome journey!