Supplemental material for

Overview of the MOSAiC expedition: Physical Oceanography

Text S1. Details of instruments and methods

This supplementary section details the instruments and methods used during fieldwork and processing to the level available at time of publication. It is intended as a guideline for potentially interested readers who want to use the data at a later stage, once processed and published, or use examples to plan future field campaigns. For acronym definitions and corresponding figures not shown here, please refer to the main text.

a. Primary profiling CTD operations

(i) PS-CTD and OC-CTD: CTD/rosette from *Polarstern* and Ocean City

Conductivity-Temperature profiles with depth (CTD) were collected routinely from the ship (the PS-CTD) and from the Ocean City (OC-CTD), but such operations were obviously challenging in winter. Therefore, heated shelters and hole maintenance were required to protect the sensors and facilitate measurements.

The heated shelter of the PS-CTD (Figure 6a) consisted of a circular frame lined with a heated blanket and covered by an insulating layer, with the option to connect a supply of hot air during operation. The PS-CTD was covered by this shelter when it was moved from inside the heated *Polarstern*, over the deck, towards the *Polarstern*-hydrohole. When the CTD was lowered into the water, the shelter was left on the ice. After the upcast, the PS-CTD was heaved directly into the shelter, to prevent freezing of the wet sensors and water samples. This procedure was sufficient to protect the sensors down to about –20°C. At lower air temperatures the sensors were filled with a saltwater-ethanol solution, as an additional protective measure from Leg 2 onwards. Operation was challenging: in particular the air supply did not retain enough heat from the air heater inside *Polarstern* to the shelter, as the air hoses lost a significant amount of the heat. Additional heat blankets were installed in the shelter, and the temperature monitored near the bottom of the CTD frame during deployment and recovery to ensure above-freezing temperatures for sensors and sample water. Any remaining issues with freezing of sensors or bottles were diligently included in sample logs.

Care was taken to keep both the *Polarstern*-hydrohole and the Ocean City-hydrohole clean of refreezing ice. This was accomplished first by a water stirrer, used conventionally in yacht harbours during the freezing season. Later, a heated, removable tent (*Polarstern*-hydrohole) and additional heating in the fixed Ocean City tent (Ocean City-hydrohole) were used with the stirrer switched off during long times without operation (e.g., at night), as this approach was found to be more efficient at keeping ice formation in each hydrohole to a minimum.

(ii) SST-CTD: stand-alone CTD

We used two identical sensor packages of the fishing rod SST 48M CTD, #1495 and 1459, to have at least one sensor available for measurements in the field at any time. For additional calibration, the SST 48M was mounted three times on the PS-CTD on shallow (< 1000 m depth) profiles (Leg 2 and 4) and six times on the OC-CTD (Leg 3). These calibration casts show a deviation in temperature (approximately 0.006°C) close to the sensor accuracy for both sensors in layers with small vertical gradients. The salinity difference of sensor #1459 to the PS-CTD was about 0.008 g kg^{-1} for both casts, similar to what we found using the OC-CTD casts during Leg 3. At the same time, sensor #1495 showed much higher salinity differences, about 0.03 g kg^{-1} for both Leg 3 and Leg 2 calibration casts, and was no longer used thereafter.

(iii) XCTD: expendable CTD

The XCTD system was manufactured by Tsurumi-Seiki Co. Ltd. (Yokohama, Japan) and was used with an XCTD-1 probe. The probe can obtain data down to 1100 m (reliably to 1000 m) and can be used at ship or drift speeds from 0 to 15 kn. The system consisted of a launcher for expendable CTD probes and a mobile deck-unit (MK-150) for data acquisition (see also Itoh and Shimada, 2003). The probe sinks down with constant velocity measuring temperature and conductivity using a set of unpumped sensors.

b. Water sampling

Here we detail further with the different sample variables and procedures. Generally, salinity samples were collected first from dedicated bottles that were not used for tracer gas sampling; otherwise, tracers were first.

(i) Salt sampling for conductivity correction

The depths of salt sampling varied with each leg to accommodate other projects and other team water needs. For all legs, samples were collected during each weekly full-depth PS-CTD cast; during Leg 3, as the *Polarstern*-hydrohole closed, they were collected weekly from the OC-CTD. All legs collected samples at depths with low salinity gradients. On the day before samples were analyzed, sealed bottles were heated in a water bath at 30°C to allow for outgassing, and excess pressure was released by sticking an injection needle through the rubber cap. Directly after sampling, bottles were sealed with a rubber cap and an aluminum clamp. From each individual sample, three salinity measurements were performed using an Optimate Precision Salinometer in the temperature-controlled laboratory onboard. Each measuring session was started and ended by measuring one Standard Seawater Sample for calibration. Additional samples were taken for analysis at home, to measure density.

The time between sample collection and analysis also varied with each leg, owing to different workloads and team composition. Legs 1 and 5 analyzed the samples 1 to 3 days after collection; Legs 2 to 4, up to several weeks after.

(ii) Chlorofluorocarbons (CFCs), sulfur hexafluoride (SF6), tritium (3H), helium (He) and neon (Ne)

Transient tracer samples (CFCs, SF6, 3H) were collected throughout the entire water column from PS-CTD by filling 100-ml glass ampoules. Prior to sampling, the metal tubing and intake adapter were cleaned with isopropanol to remove any fat, and the person sampling made sure to not directly touch these parts. The ampoules were purged for 3 min before being filled and securely made airtight. Flame-sealing started immediately after the sampling, but due to the large number of samples and the fact that only one sample could be sealed at a time, up to 6 hours occurred between sampling and the sealing of the last ampoule.

Noble gases (He, Ne) were collected in the upper 500 m either from PS-CTD or OC-CTD (depending on the leg and floe conditions) using 50-ml copper tubes. They were collected straight after the transient tracer samples if at the same rosette bottle and collected first if no transient tracer sample was needed at that bottle. The person sampling took great care to rid the plastic tubing for sampling of any bubble by letting the water flow for as long as necessary, and by regularly hitting the copper tube with a wrench. Noble gas samples and flame-sealed transient tracer samples were stored onboard until the end of the expedition, and they are currently being analyzed at the University of Bremen, Germany, following standard procedures (Bulsiewicz et al., 1998; Sültenfuß et al., 2009).

(iii) Isotopes of water and rare earth elements concentrations

Samples for $\delta^{18}O$ and δD were taken with the OC-CTD during Legs 1–3 and from the PS-CTD during Legs 4 and 5. The samples were collected in glass bottles (50 ml) leaving a 1–2 cm headspace and closed tightly with a screw cap. Bottles were stored on-board at about 5–15°C.

The analysis was performed at two different laboratories with standard spectrometric methods (see Meyer et al., 2000, and Bauch et al., 2011).

Samples for dissolved radiogenic Nd isotopes and REEs were taken from the OC-CTD by combining the water from two bottles closed at the same water depth. The large-volume water samples were collected directly from the bottles into acid-cleaned LDPE 10-L containers. The samples were processed and analyzed at GEOMAR following standard procedures (see Laukert et al., 2017c and references therein).

(iv) Cosmic ray isotope beryllium

Samples of Beryllium 7 (^{7}Be) were taken from the Ocean City-hydrohole through the ice (approximately 1–3 depths) with large-volume pumps or taken from the *Polarstern* seawater intake (approximately 8m). Typically, about 1400 L were used for each depth. Mixed layer samples were taken weekly and hydrohole sampling occurred every 2–3 weeks. The water was pumped through Fe-impregnated fibers which adsorb the ^{7}Be. The fibers were dried and shipped to Florida International University. There, the fibers were ashed and placed on a gamma detector for analysis (Kadko et al, 2016).

c. Microstructure profiling

(i) MSS: downward profiler

The MSS is a loosely-tethered microstructure profiler (MSS90, Sea and Sun Technology, Germany) with a power and data connection to a deck-unit during operation. Over the course of the MOSAiC drift, five different probes were used, some of them equipped with additional sensors (dissolved oxygen, chlorophyll *a* fluorescence, and/or turbidity), one of them a self-contained prototype only used for testing. Measurements were carried out at least 300 m away from the vessel, to avoid biases in the data close to the surface induced by turbulence generated by the *Polarstern* keel. During Legs 1–3, the MSS was deployed through the Ocean City-hydrohole in the heated Ocean City tent (winch and profiler with orange cable, Figure 5b), which was not set up again during the later legs. During Legs 4 and 5, measurements were carried out directly from the ice (Figure 5e), with an optional unheated pop-up tent as shelter (Figure 5f). During Leg 4, a melt pond adjacent to the Ocean City-hydrohole used for microstructure profiling quickly expanded and started to drain through the hole.

(ii) VMP: uprising profiler

The VMP is a 250-m rated, positively buoyant (“upriser”) microstructure profiler (VMP), designed by Rockland Scientific. It records internally, is battery-powered, and provides high-resolution vertical profiles of turbulence dissipation rate from two velocity, microconductivity and temperature. The VMP is lowered with a weight that is electrically released at a target depth. The instrument records data during its ascent until it hits the underside of sea ice or breaks the surface in leads. The instrument was used during Legs 4 and 5 from the ice without shelter, and to a limited extent during Legs 2–3 from the Ocean City tent (Figure 5a–c). Data processing followed the recommended procedures and was conducted using the routines provided by Rockland Scientific. Particular attention was paid to remove portions of each profile affected by the wake of the instrument and the deployment weight. Temperature and conductivity data were calibrated using the closest in time and space temperature and salinity profile (from either the MSS or PS-CTD).

d. Underway operations

(i) 150 kHz ADCP: Shipboard Acoustic Doppler Current Profiler (SADCP)

The shipboard ADCP (SADCP) installed on *Polarstern* is an Ocean Surveyor (frequency 150 kHz, beam angle 30°), manufactured by *Teledyne* RD-Instruments, was mounted downward looking in a sealed space behind a window in the Polarstern hull, flooded with water. The data output of the SADCP was merged online with the corresponding navigation data and stored on the hard disc using the software VmDas (Teledyne RD-Instruments). Pitch, roll and heading data from *Polarstern* sensors were directly ingested to the acquisition system. Current data were collected in beam coordinates to apply all corrections during post processing.

The pinging schedule for the different acoustic devices operating on *Polarstern* was modified in coordination with the scientific parties on-board during October 17–27, 2019, and the optimized configuration implemented during the early part of Leg 1. The one major change from the usual configuration was to switch the SADCP data bin size from 4 m to 8 m, due to extremely low backscattering level in the water. The bin-size remained at 8 m during the subsequent legs and was only changed back to 4 m during Leg 5. The instrument was configured in narrowband mode and set up to cover a range from 15 m to about 240 m (the latter value depending mainly on the backscatter signals during the time of the drift). VmDas was used to set the operating parameters of the SADCP and to record the data. We used both a long-term and a short-term averaging interval of 20 min and 5 min, respectively. The heading bias of the instrument will be applied during post processing.

(ii) Thermosalinograph: measurements from the pumped seawater intake

This instrument system was the responsibility of the *Polarstern* crew. The system consists of two SBE21 SeaCAT Thermosalinographs with an additional external thermometer SBE38 to determine thermal adjustment of the pumped water while passing through *Polarstern* to the SBE21. The two SBE21 are operated in parallel on the same seawater intake throughout the drift. The system is located in the *Polarstern* keel with the water intake at about 11-m depth, depending on the *Polarstern* draft. Regular salt samples for calibration were taken and analyzed in the same way as those taken for the CTD/rosette systems (see Section b.i, this supplement). After post-cruise calibration and processing, the data have been published, together with a detailed description of the system and processing (Rex et al., 2021b; 2021c; 2021d; Kanzow et al., 2021; and Haas et al., 2021).

e. Long deployments of autonomous devices

Some of the measurement systems that we deployed in the ice of the Central Observatory were linked to *Polarstern* via LAN/WIFI to allow remote changes of measurement parameters and data download. Others only operated with pre-programmed parameters and stored data internally.

(i) AOFB: ice-ocean momentum, heat and salt fluxes

The Teledyne RD-Instruments ADCP (300 KHz) measured current profiles with 2-m vertical resolution. The flux sensor at 3-m depth was an eddy-correlation system (e.g., Stanton et al., 2012). The system was deployed along with the Distributed Network on the boundary of an area of new ice and the rough ice rubble field that dominated the Central Observatory. During operation from Leg 1 the system measured in a range of upstream conditions for both the ocean and atmospheric boundary layers before being lost by ice deformation during Leg 3. Another recovered unit from the Distributed Network was deployed in the Central Observatory during Leg 5.

(ii) Pycnocline Spar: upper pycnocline turbulent diffusivity and heat flux time series

This sensor system continuously measured the fine-scale thermal structure and thermal microstructure sampled at 200 Hz to allow the thermal dissipation rates and the local thermal temperature gradients to be resolved through a 6-m thick slab of the stratified pycnocline. The

ADCP on the ocean flux system provided estimates of the local vertical shear, and microcat CT sensors at the top and bottom of the 6-m frame measured the local density gradient.

(iii) 75 kHz ADCP: under-ice current profiler with external compass and GPS unit

The Teledyne RD-Instruments 75 kHz ADCP was deployed pointing downward through a temporary hydrohole in the ice. Because magnetic compasses can be unreliable at high latitudes, an external SIMRAD HS60 GPS unit with compass was placed on the ice adjacent to the instrument. The ADCP was mounted in a frame that did not allow the instrument to rotate in the water and the GPS was manually aligned with beam 3 of the ADCP. During Legs 1–3 and 5, the instrument was powered from *Polarstern*, and sampled and recorded profiles at 5-s intervals (i.e., “single ping” sampling), in 74 depth bins of 8-m thickness. The instrument was cabled and data were logged directly to a PC onboard *Polarstern*. During Leg 4, the instrument recorded self-contained using 20-min ensemble averages of 60 profiles with the same vertical resolution. All measurements were made in beam coordinates. After quality checking the ADCP data in beam coordinates, the external compass was used to map the velocity from beam coordinates to geo-referenced east-north coordinates. Ice drift velocity was obtained from the external GPS, and removed from the ice-relative ADCP velocities to obtain absolute water velocities. We verified the external compass by comparison to a deep layer in the profile assumed to be “stagnant”. For further details see the data publication (Baumann et al., 2021).

(iv) 300 kHz ADCP: current profiler in Ocean City-hydrohole

A The ADCPT, a Teledyne RD instruments 300 KHz “Workhorse” ADCP, was deployed in the Ocean City-hydrohole at times when the hole was not used for large profiling devices, such as the OC-CTD (Legs 2, 3), and in different hydroholes across the Central Observatory (Legs 4, 5). The ADCP was mounted in a stainless-steel frame that kept the heading of the ADCP fixed relative to the heading of the floe during each time slot of continuous operation. The ADCP was operated with varying parameters, usually 2-m vertical bins and one ping every second. The system gathered reliable data of relative horizontal currents and vertical shear in the upper 50 m of the water column, covering most of the upper mixed-layer and providing higher vertical resolution than given by the 75 KHz ADCP and the 150 kHz ADCP. Absolute velocity can be obtained by comparing vertically overlapping measurements of the 300 KHz ADCP with the 75 KHz ADCP and the 150 kHz ADCP. The time series was interrupted by other instruments operating in the hydrohole, power supply failures, and maintenance, such as changing of the memory cards once a week.

(v) Turbulence Cluster

Each of the three clusters was equipped with a SBE37 Microcat (CTD, sampling at 5-min interval), a SAMIpCO2 (180-min interval) and a five-beam Nortek S1000 ADCP (15-min burst at 2 Hz followed by a 5-min break). Each ADCP was attached to a hinged arm that was aligned with the mooring wire during deployment (to make it possible to deploy through a small hole in the ice) and swung to a horizontal position in the water. The ADCP were attached at the end of the arm away from the mooring wire, pointing downward, all 5 beams had a clear view. Power for the clusters was provided by *Polarstern* via an on-ice surface unit, which also collected the data.

The SBE37 inside the Turbulence cluster ceased operation on February 2, 2020, due to unforeseen internal battery consumption during data transmission. When *Polarstern* left the floe in mid-May, the clusters remained in the water and were equipped with additional external batteries in an effort to prolong the time series as much as possible.

The SBE37 data are processed using the standard Seabird software; the ADCP, Nortek Signature software. Due to expected problems with the internal compasses, we used the heading from the external on-ice GPS unit collocated with the 75kHz ADCP to obtain reliable current directions for the ensemble-averaged currents. The burst data were recorded in beam coordinates and for the purpose of turbulence estimates a translation into geo-referenced coordinates is not necessary. For unknown reasons (possibly linked to power outages in early 2020), all three ADCP suffered data quality problems, starting with the top instrument in early March, followed by the middle instrument in mid-March and finally the lowest instrument by the end of April. Despite being provided with additional battery packs at the surface unit, all Nortek ADCP ceased operation when *Polarstern* departed the floe.

(vi) MR: temperature-salinity chain and temperature microstructure

The Microrider by Rockland Scientific measured temperature microstructure. Complementing these observations, the mooring was equipped with a 200-m long thermistor chain by RBR containing 24 evenly spaced thermistors, and four Concerto CTD units (sampling rate of 5 min) by RBR. A surface unit was installed to provide power to the Microrider and allow for data-downloads from all instruments. Equipped with two FP07 micro-temperature probes by Thermometrics, the Microrider was set up to continuously measure at 512 Hz. A detailed description of processing, quality control and post-processing will be provided in later publications. After deployment of the Microrider/thermistor chain mooring the Microrider performed well, but only 5 of the 24 sensors on the thermistor chain provided realistic data. Within a month, only two thermistors were functional, and from February 2020 onward, only one thermistor appeared to work, albeit with poor data quality.

(vii) Aural: autonomous underwater hydroacoustic recorder

The Aural M2 autonomous underwater hydroacoustic recorder by Multi electronique (Quebec, Canada) was installed through a temporary hydrohole on October 29, 2019, deployed on a Kevlar rope and attached to two surface floats, in case of ice breakup. The instrument was configured to internally record hydroacoustic data for 7 min on each hour. The Aural was recovered by kayak from a decaying piece of ice on July 14, 2020.

(viii) Ridge site instruments: velocity, shear, turbulence and CTD

The two sets of instruments contained one Nortek Signature 1000 ADCP and one RBR Concerto CTD. The ADCPs were deployed at end of a pole that reached through the ice, with the power and data cable reaching the ice surface to allow temporary maintenance. They were set to set to record in 1-m vertical bins with a maximum range of 20 m every hour, with additional high-accuracy burst profiles with 0.5-m vertical bins to 28-m range every 2 h. The latter also recorded turbulence variables in 0.02-m vertical bins to about 5-m range. The two CTDs were deployed next to ADCPs hanging below the ice and recorded at a frequency of 2 Hz. Access to the site was intermittently restricted due to ice deformation, so that not all data from the ADCP Signature 1000 and the RBR Concerto CTD could be downloaded, and most of the instruments were eventually lost.

The Leg 5 ridge instruments comprised a Nortek Vector Eddy covariance system with additional sensors for fast temperature and dissolved oxygen, as well as a Nortek Aquadopp ADCP. The 3 GPS tracker buoys were Marlin Yug Iridium IceST/20. The Aquadopp mesaured multilayer current with 4-m vertical resolution and the GPS buoy array ice velocity, where temporal resolution is 10 min for both kinds. The eddy covariance system unfortunately failed to record velocity at a small volume, 14 cm ahead of the transducers. The failure was plausibly due to an overlapped obstacle as dissolved oxygen sensor’s metal arm on the way of beams. Time series of 32 Hz temperature and dissolved oxygen, from the eddy covariance system, were collected with a 10-min burst interval as planned.

(ix) Tpop: bottom temperature recorders

The autonomous bottom temperature sensors “Tpop” , manufactured by the University of Rhode Island (USA), were encased in a full-depth rated shell of approximately 30-cm diameter. They record the temperature at the bottom of the ocean up to 3 times per hour for up to several years before automatically burning their connection to the anchor and naturally floating to the surface to send their data via satellite. If trapped under ice, they wait, undamaged, until they either succeed in sending their data or run out of battery.

(x) Temporary temperature and salinity chains

The Leg 2 deployment of self-contained CTD packages without telemetry at the SYI coring site consisted of a Concerto CTD by RBR, two SBE-SM37 and a Duet TD logger by RBR. The instruments were distributed at about 5, 25 and 60 m depth and set to measure every 30 seconds. The system was recovered during Leg 4 but the two SBE-SM37 only stored data until April 2, 2020.

During leg 5, 4 SBE37 microcats were installed at the edge of a newly formed lead on August 31, 2020. The instruments were placed at depths of 1, 2, 4 and 8 m, and configured to record data every 60 s. This chain had to be relocated on September 6, 2020, to avoid the loss of the instruments because the lead was subsequently closing and danger of ridge formation was imminent. The new location was right next to the Remote Sensing site, approximately 100 m from the old location, and the lead width was 30 m (with a 2-m wide opening in the middle). The instruments were recovered on September 19, under newly-formed ice about 10 cm thick. A second chain with 5 SBE37 microcats was deployed about 150 m from *Polarstern* (SIT in Figure 4b), measuring at depths of 10, 20, 50, 75 and 100 m, and recording every 2 min. This system is designed to telemeter data via satellite and was left on the ice after the end of Leg 5 to continue measuring. A third chain consisting of 3 Solumetrix BKIN50 conductivity cells installed at depths of 10, 25 and 45 m was deployed between the coring triangle and the buoy site on August 28, 2020 (TS-chain in Figure 4b). The main purpose of this deployment was a field test, and a comparison to standard instruments from RBR and Seabird is planned. The Solumetrix conductivity cells are more affordable than the RBR and Seabird sensors, and the potential of this new development needs to be assessed. The instrument was retrieved on September 19, 2020.

A platform consisting of a Concerto CTD by RBR along with a SUNA nitrate sensor equipped with an external battery pack was installed on August 31, 2020, on the main road close to the Met City junction, approximately 100 m from Ocean City (“Nitrate Village” in Figure 4b). The continuously measuring instruments were mostly deployed at a depth of 10–20 m, and opportunistically profiled between the surface and 100-m depth. In order to calibrate the SUNA later on, water samples for nutrients were collected 3 times at 2, 5 10 and 20 m.

Table S1. Table of contributing projects.

Project title	**PIs and researchers**	**Funding**	**Teams involved**
Advective Pathways of nutrients and key Ecological substances in the ARctic (APEAR)	Yevgeny Aksenov, Benjamin Rabe, Myriel Vredenborg	Natural Environment Research Council (UK), Federal Ministry of Education and Research (DE)	Ocean
Arctic Ocean mixing processes and vertical fluxes of energy and matter (AROMA)	Ilker Fer	Norwegian Research Council (NO)	Ocean
D-TOP profilers (physics and biooptics)	Tao Li	Chinese Arctic and Antarctic Administration (CN)	Ocean
Eddy Properties and Impacts in the Changing Arctic (EPICA)	Qiang Wang, Dmitry Sein, Ivan Kuznetsov, Sergey Danilov, Benjamin Rabe, Thomas Jung, Torsten Kanzow, Nikolay Koldunov, Dmitry Sidorenko, Claudia Wekerle	Federal Ministry of Education and Research (DE)	Ocean
Ridges - Safe HAvens for ice-associated flora and fauna in a seasonally ice-covered Arctic OCean (HAVOC)	Mats Granskog	Norwegian Research Council (NO)	Sea ice, Ecosystem, Ocean
Interaction between atmosphere and the upper Arctic Ocean under Arctic: Amplification: the role of sea ice related processes	Maren Walter, Monika Rhein, Christian Mertens	German Research Foundation (DE)	Ocean
Joint Arctic research on New and Unusual States (JANUS)	Jun Inoue, Daiki Nomura, Yusuke Kawaguchi, Tomoe Nasuno	Japan Society for the Promotion of Science (JP)	Atmosphere, Ocean, BGC
AWI multidisciplinary buoys (MIDO)	Benjamin Rabe, Mario Hoppmann, Marcel Nicolaus	Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (DE)	Ocean, Sea ice

Project title	**PIs and researchers**	**Funding**	**Teams involved**
M-VRE: The MOSAiC Virtual Research Environment	Sebastian Mieruch-Schnülle, Merret Buurman, Marcus Paradies	Federal Ministry of Education and Research (DE)	Ocean, Data
Primary productivity driven by Escalating Arctic NUTrient fluxeS? (PEANUTS)	Markus Janout, Yueng-Djern Lenn, Kirstin Schulz, Sinhue Torres-Valdes	Natural Environment Research Council (UK), Federal Ministry of Education and Research (DE)	Ocean
Profiler and fixed-layer buoy for upper ocean of the arctic ocean	Yan He, Bin Kong	Chinese Arctic and Antarctic Administration (CN)	Ocean
Chinese Polar Environmental Comprehensive Investigation & Assessment Programs	Hailun He	Chinese Arctic and Antarctic Administration (CN)	Ocean
SubMesoscale DYnamics and Nutrients (SMEDYN)	Benjamin Rabe, Sinhue Torres-Valdes, Ivan Kuznetsov, Markus Janout, Torsten Kanzow, Boris Koch	Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (DE)	Ocean, Ecosystem, Modelling
(Sub)mesoscale ocean circulation and processes during MOSAiC	Benjamin Rabe, Ivan Kuznetsov, Ying-Chih Fang	Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (DE)	Ocean
Thermodynamic and dynamic drivers for the Arctic sea-ice mass budget	Matthew Shupe, Tim Stanton, Don Perovich, Jennifer Hutchings, Chris Fairall, Ola Persson, Amy Solomon	National Science Foundation (US)	Sea ice, Atmosphere, Ocean
Why is the deep Arctic Ocean Warming? (WAOW)	Céline Heuzé	Swedish Research Council (SE)	Ocean, Ecosystem, Sea ice, BGC

Project title	**PIs and researchers**	**Funding**	**Teams involved**
Simulation, Prediction and Regional Climate Response of Global Warming Hiatus	Hailong Liu, Meng Zho	Chinese Arctic and Antarctic Administration (CN)	Ocean
Defining the Atmospheric Deposition of Trace Elements into the Arctic Ocean-Ice Ecosystem During the Year-Long MOSAiC Ice Drift	David Kadko	National Science Foundation (US)	BGC, Ocean

Table S2. Definition of water masses represented in Figure 9.

Water mass / layer boundary name	Upper limit	Lower limit	Further constraints / comments	Reference
Polar Surface Water (PSW)	Surface	$\Theta = \Theta_{\mathrm{min}}$	-	Korhonen et al. (2013)
Upper halocline (UHC)	$\Theta = \Theta_{\mathrm{min}}$	$S_A = 34$ g kg^{-1}	-	Korhonen et al. (2013)
Lower halocline (LHC)	$S_A = 34$ g kg^{-1}	$\Theta = 0$°C	-	Korhonen et al. (2013)
Upper Atlantic Water (AW1)	$\Theta = 0$°C;	$\Theta = \Theta_{\mathrm{max}}$	-	Korhonen et al. (2013)
Lower Atlantic Water (AW2)	$\Theta = \Theta_{\mathrm{max}}$	$\Theta = 0$°C	-	Korhonen et al. (2013)
Upper Polar Deep Water (UPDW)	Below AW2	$p = 1000$ dbar	-	Korhonen et al. (2013)
Arctic Intermediate Water (AIW)	$p = 1000$ dbar	$\Theta = –0.5$°C	-	Rudels (2009)
Canada Basin Deep Water (CBDW)	$\sigma_{0.5} = 30.444$ kg m^{-3}	$\sigma_{1.5} = 35.142$ kg m^{-3}	In Eurasian Basin, tends to intrude the EBDW layer. Detectable as local salinity maximum around 2000-m depth	Rudels (2009)
Eurasian Basian Deep Water (EBDW)	Below UPDW	$\sigma_2 = 37.46$ kg m^{-3}	-	Smethie et al. (1988)
Eurasian Basin Bottom Water (EBBW)	$\sigma_2 = 37.46$ kg m^{-3}	Seafloor	Bottom 600–1000 m sometimes homogeneous, cause unclear, geothermy suspected (Rudels, 2013)	Smethie et al. (1988)