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

EXPEDITION PROGRAMME PS115/2

Polarstern

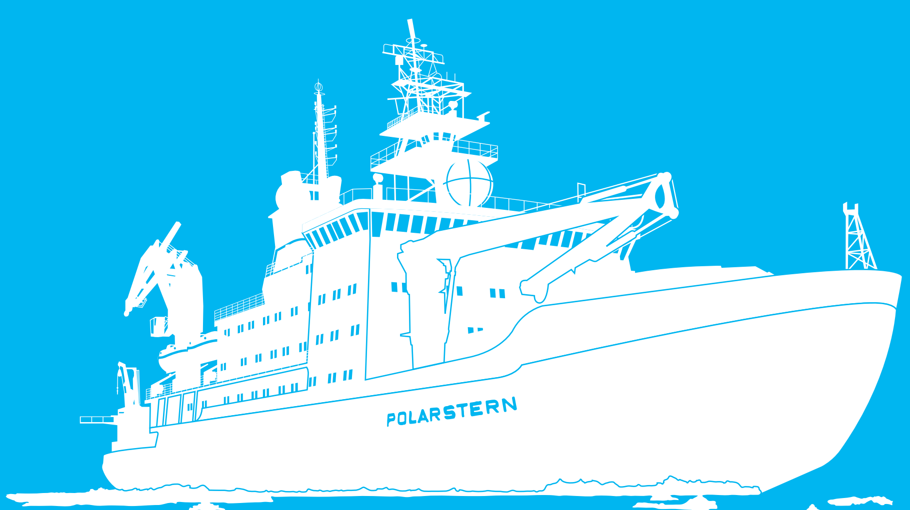
PS115/2

Longyearbyen - Bremerhaven

05 September 2018 - 16 October 2018

Coordinator: Rainer Knust

Chief Scientist: Ruediger Stein



Bremerhaven, July 2018

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Contents

1. ÜBERBLICK UND FAHRTVERLAUF

Ruediger Stein (AWI)

Übergeordnetes Ziel des geowissenschaftlichen Hauptprogramms von *Polarstern*-Expedition PS115/2 ("***P****olarstern* **Arc**tic **O**cean **P**aleoceanography – PArcOP") liegt auf der Rekonstruktion der tektonischen und klimatischen Entwicklung des Arktischen Ozean. Das Hauptarbeitsgebiet, d.h. der zentrale Arktische Ozean mit südlichem Lomonosov-Rücken und angrenzendem Sibirischen Kontinentalrand (Abb. 1 und 2), als auch die wissenschaftlichen Schwerpunktthemen stehen in direktem Zusammenhang mit der IODP-Expedition 377 ("**Arc**tic **O**cean **P**aleoceanography - ArcOP"; siehe Stein, 2017 für weitere Hintergrundinformationen). Die IODP Expedition 377, ursprünglich als „Joint Venture“ zusammen mit dieser *Polarstern*-Expedition geplant, ist für 2018 leider gestrichen worden, ist aber in der Endphase des laufenden IODP-Programms noch möglich (2021?, 2022? oder 2023?).

Bei den geplanten marin-geologischen Arbeiten der Expedition PS115/2 stehen (1) die zeitlich möglichst hochaufgelöste Rekonstruktion der Änderungen von Meereisbedeckung, Paläo–produktivität, paläoozeanischer Zirkulation und Paläoklima im Arktischen Ozean während des Spätquartärs und (2) die Langzeitentwicklung des Paläoklimas im Verlauf des Känozoikums im Vordergrund. Hierzu sollen an gezielt ausgesuchten Lokationen Sedimentkerne für detaillierte sedimentologische, geochemische und mikropaläontologische Untersuchungen gewonnen werden. Die neuen seismischen Daten werden – in Kombination mit den seismischen Profilen der Expedition PS87 – wichtige neue Informationen zur sedimentären und tektonischen Geschichte des arktischen Ozeans und der angrenzenden Schelfgebiete liefern. Falls die Eisbedingungen es erlauben, werden seismische Profilfahrten zur Verbindung der seismischen Profile im Umfeld der ACEX-Bohrung mit dem existierenden seismischen Netzwerk der Expedition PS87 (Gebiet 2 in Abb. 2) erste Priorität im geowissenschaftlichen Programm der Expedition PS115/2 einnehmen.

Polarstern wird am 05. September 2018 aus Longyearbyen/Svalbard zur Expedition PS115/2 nach Norden auslaufen und weiter Richtung Lomonosov-Rücken dampfen. Es ist geplant, dass das Schiff - abhängig von den Wetter- und Eisbedingungen - das Hauptarbeitsgebiet (Lomonosov-Rücken) ca. am 12. September erreicht (Abb. 1). Auf der Fahrt Richtung Lomonosov-Rücken werden bereits meteorologische, meereisphysikalische und geowissenschaftliche Arbeiten bzw. Beobachtungen durchgeführt sowie Driftbojen für automatische Messungen von Oberflächenwasserzirkulation/Eisdrift, Luftdruck und Oberflächentemperatur ausgebracht. Im Arbeitsgebiet liegt dann der Schwerpunkt auf geophysikalischen Vermessungen und geologischer Probennahme. Weiterhin ist das Aussetzen von vier „Ocean Bottom Seismometers (OBS)“ am Gakkel-Rücken geplant, um Mikroerdbeben zu erfassen. Begleitend werden die meereisphysikalischen Messungen /Beobachtungen fortgeführt. Eine Angabe von exakten Stationsdaten ist vorab nicht möglich, da die Fahrtroute nur generell geplant werden kann und die Eisbedingungen zum Zeitpunkt der Expedition unbekannt sind. Für die Arbeiten im Hauptarbeitsgebiet sind ca. drei Wochen veranschlagt. Alle diese Arbeiten finden in internationalen Wässern, d.h. außerhalb der russischen Exklusiven Wirtschaftszone (EWZ) (Abb. 1), statt. Nach Abschluss der Arbeiten wird Polarstern Richtung Vilkitsky-Straße dampfen und voraussichtlich am 03. Oktober bei ca. 78.5°N 120°E die Grenze zur russischen EWZ überqueren. Die Rückfahrt soll weitgehend entlang der Northern Sea Route erfolgen. Es ist geplant, die russische EWZ etwa bei 30°E spätestens am 09. Oktober Richtung Bremerhaven zu verlassen. Die Expedition PS115/2 endet dann am 16. Oktober 2018 in Bremerhaven.

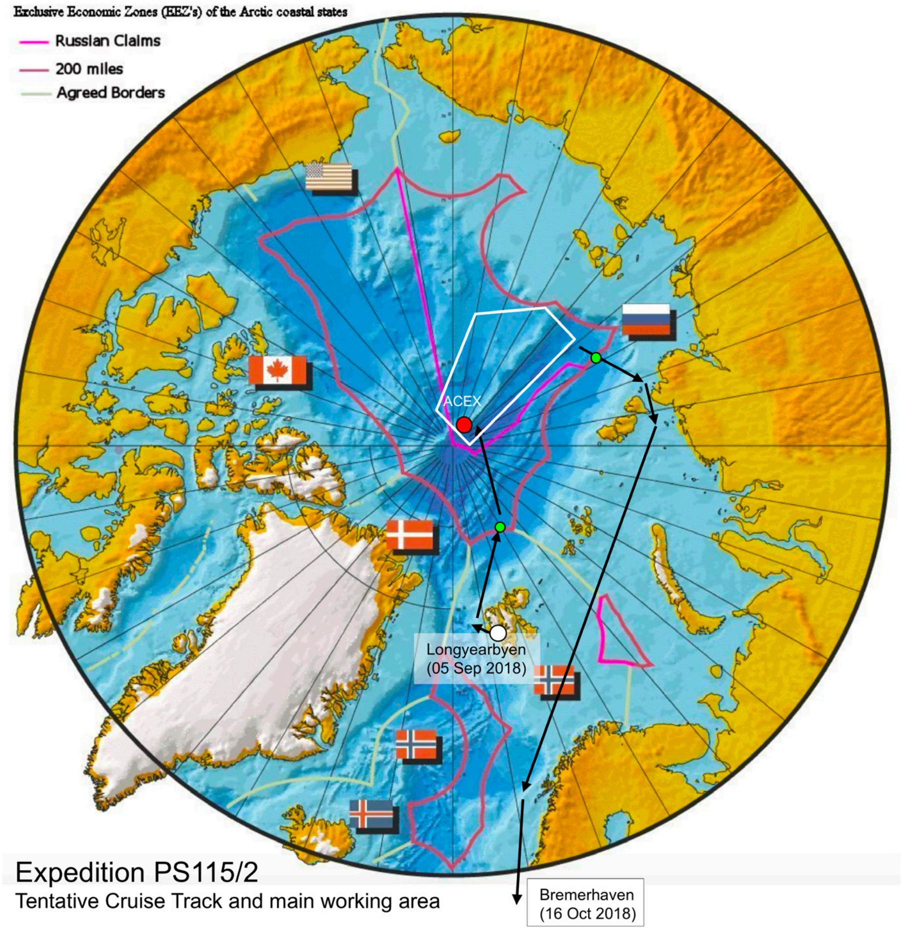

Abb. 1: Vorläufige Fahrtroute und Hauptarbeitsgebiet der Expedition PS115/2
Fig. 1: Tentative cruise track and main working area of Expedition PS115/2

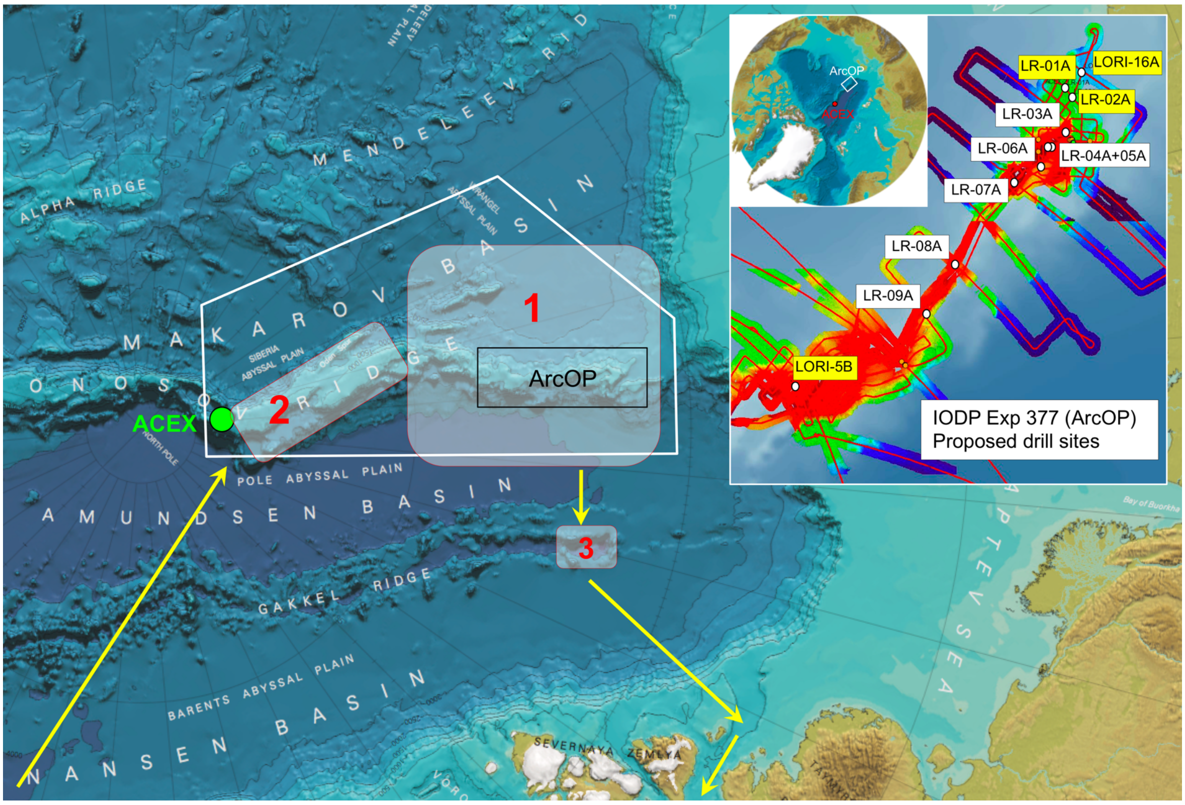

Abb. 2: Hauptarbeitsgebiet der Expedition PS115/2 mit (1) Arbeitsgebiet im Umfeld der geplanten IODP Expedition 377 (ArcOP), (2) Arbeitsgebiet für seismische Profilfahrten, um die seismischen ACEX-Profile mit dem seismischen Profilnetz der Expedition PS87 (Stein, 2016) zu verbinden, und (3) „Gakkel Deep"-Region, wo OBS-Systeme ausgesetzt werden sollen. Karte rechts oben zeigt mögliche Lokationen für IODP-Bohrungen im Rahmen der IODP Expedition 377 (ArcOP; Stein et al., 2015; Stein, 2017) und Profillinien der Hydrosweep-Vermessungen während Expedition PS87 (Stein, 2015).

Fig. 2: Main working area of Expedition PS115/2 with (1) key working area in the surroundings of IODP Expedition 377 (ArcOP), (2) area for seismic survey to connect with the seismic network at the ACEX drilling location on the central Lomonosov Ridge and the ArcOP seismic lines recorded during the PS87 Expedition (Stein, 2016), and (3) Gakkel Deep area for deployment of ocean bottom seismometers (OBS). Map in the right upper corner display locations proposed drill sites for IODP Expedition 377 (ArcOP; details in Stein et al., 2015; Stein, 2017) and tracks of PS87 Hydrosweep survey (Stein, 2015).

SUMMARY AND ITINERARY

The overall goal of the PS115/2 geoscience programme is to enhance our insights into the tectonic evolution, climate history and related sedimentary processes in the Central Arctic Ocean, based on seismic reflection and marine-geological data. These new data will contribute to a better understanding of the link between tectonics and climate changes in the Arctic. Key research areas of Expedition PS115/2 ("***P**olarstern* **Arc**tic **O**cean **P**aleoceanography – PArcOP") are the central Arctic Ocean and the southern Lomonosov Ridge close to the Laptev

Sea continental margin, i.e., the dedicated area of IODP Expedition 377 (Figs. 1 and 2). In this area seismic profiling and geological coring activities – closely related to the objectives of IODP Expedition 377 (“**Arc**tic **O**cean **P**aleoceanography - ArcOP“; see Stein 2017 for background and references) – will be the main focus. In combination with IODP Expedition 377 that unfortunately has been cancelled for 2018 but still might be scheduled during the final phase of IODP (20021? 2022? 2023?), the key objectives of the marine-geological research programme of Expedition PS115/2 are (1) high-resolution studies of Quaternary changes in paleoclimate, especially circum-Arctic ice sheets, sea-ice cover, and surface- and deep-water characteristics and (2) detailed reconstructions of the long-term climate history of the Arctic Ocean during Cenozoic times. Thus, a detailed coring programme will be carried out in the neighbourhood of the potential IODP drill holes (Fig. 2) to sample the near-surface sedimentary sections. Seismic data acquisition will be carried out across the central and southern part of the Lomonosov Ridge, supplementing the profiles obtained during *Polarstern* Expedition PS87 in 2014. If ice conditions allow, a first-order geoscience activity will be a seismic survey in area (2) of Fig. 2 to connect the seismic network at the ACEX drilling location on the central Lomonosov Ridge and the ArcOP seismic lines recorded during the PS87 Expedition. The new seismic data will provide new insights into the tectonic and sedimentary evolution of the Arctic Ocean and the adjacent continental shelves.

In addition to the geoscientific key objectives, smaller supplementary studies will be carried out, dealing with the measurements on & sampling of sea ice, melt ponds and open-water areas; the deployment of drift buoys to be deployed on ice floes or in open water to automatically record position, air pressure and surface-water temperature, and detailed radiosounding activity. Furthermore, a “Floating University” will be held onboard *Polarstern* as part of the International Research Training Group “ArcTrain” (*Processes and impacts of climate change in the North Atlantic Ocean and the Canadian Arctic*) qualification and education programme.

Polarstern Expedition PS115/2 will start on 05 September 2018 in Longyearbyen/Svalbard. Key research areas are the Alpha Ridge and the southern Lomonosov Ridge close to the Laptev Sea continental margin that probably will be reached at about 12 September (Fig. 1). On the way towards Lomonosov Ridge already meterological, oceanographical, sea-ice-physical and geoscientific measurements/studies will be carried out. In the key study area on Lomonosov Ridge, seismic profiling and geological coring activities will be the main focus. In addition, supplementary oceanographic and sea-ice studies as well as meterological observations will be done. After about three weeks of work in the study area, *Polarstern* will start the transit back home, probably reach the Russian Exclusive Economic Zone (EEZ) on 03 October, and sail through the Northern Sea Route. On 09 October, *Polarstern* will leave the Russian EEZ, and Expedition PS115/2 will end in Bremerhaven on 16 October 2018.

References

Stein R (Ed) (2015) The Expedition PS87 of the Research Vessel *Polarstern* to the Arctic Ocean in 2014, Reports on Polar and Marine Research 688, Bremerhaven, Alfred Wegener Institute for Polar and Marine Research 688, 273 pp (http://epic.awi.de/37728/1/BzPM_0688_2015.pdf).

Stein R (2017) From Greenhouse to Icehouse: The late Mesozoic-Cenozoic Arctic Ocean sea-ice and climate history. Polarforschung 87, 61-78.

Stein R, Jokat W, Niessen F and Weigelt E (2015) Exploring the long-term Cenozoic Arctic Ocean Climate History – A challenge within the International Ocean Discovery Program (IODP). Arktos 1, doi: 10.1007/ s41063-015-012-x

2. MARINE GEOLOGY: RECONSTRUCTION OF PAST CLIMATIC CONDITIONS

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Objectives

Key goals of the marine-geological research programme of Expedition PS115/2 are detailed reconstructions of the long- and short-term climate history of the Arctic Ocean during Quaternary and pre-Quaternary times. In this context, especially studies of changes in circum-Arctic ice sheets, sea-ice cover, and surface- and deep-water characteristics are of major interest. These studies are directly related to the key objectives of IODP Expedition 377, a drilling campaign (Stein et al., 2015; Stein, 2017) that originally was scheduled for 2018 but unfortunately cancelled and postponed to the final phase of the running IODP period (2013-2023).

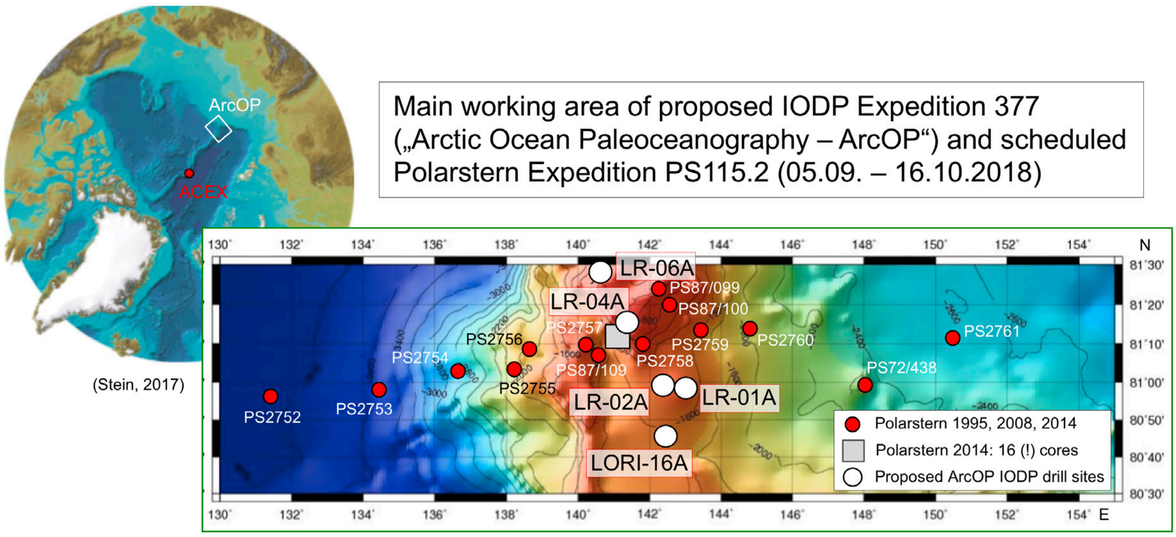

Fig. 3: West - East transect across the Lomonosov Ridge near to the Siberian continental margin showing locations of the “first-priority” ArcOP drill sites LR-01A, LR02A, LR-04A, LR-04A, and LORI-16A (large white circles) as well as the locations of numerous sediment cores recovered during Polarstern expeditions in 1995, 2008, and 2014 (red circles and blue box) (for further details and references see Stein, 2017).

Work at sea

During Expedition PS115/2, a detailed geological coring programme is planned using the Giant Box Corer (GKG), Multicorer (MUC), and Gravity (SL) and Kastenlot (KAL) Corer. In addition, direct sampling (and coring) of sea ice and sea-ice sediments will be carried out on selected ice floes.

Coring locations will be selected carefully using detailed bathymetric mapping and sub-bottom profiling systems (i.e., Hydrosweep and Parasound, respectively) to avoid areas of sediment redeposition (turbidites and slumps) and erosion, to identify areas of high and low sedimentation rates, and to identify areas where pre-Quaternary sediments are cropping out. Several of such areas have already been identified by a Parasound profiling survey during Expedition PS87. Some of these areas will be revisited during Expedition PS115/2 for a detailed coring programme that could not be carried out in 2014 due to time limitations. Another first-order programme will be the coring of undisturbed near-surface sediment sections (i.e., the uppermost about 10 m) at the selected IODP first-priority sites LR-01A, LR-04A, LR-06A, and LORI-16A (Fig. 3). At these stations also complete sub-cores will be deep-frozen for later shored-based biogeochemistry studies.

Before opening, sediment cores will be logged using the Multi-Sensor Core Logging (MSCL) system. Selected gravity cores will be opened and – as the KAL cores - described and photographed on board. Continuous sampling of selected cores will be performed in various ways and for various purposes, including several large-volume archive boxes (parallel sampling). Samples will be stored cool or frozen for further analyses in the home laboratories.

Expected results and objectives of post-cruise research

- Stratigraphic analyses of the sediment sequences, using a multi-proxy-approach (AMS14C, oxygen and carbon stable isotopes, biostratigraphy, natural radionuclides, physical properties, XRF scanning, cyclostratigraphy, and correlation to other existing Arctic Ocean records).
- Quantification and characterization of terrigenous sediment fraction in order to reconstruct transport processes, oceanic currents, and circum-Arctic ice-sheet history (Proxies/approach: grain size, clay minerals, heavy minerals, major, minor, trace and rare earth elements, organic carbon fractions, and physical properties; analytical techniques: X-ray diffraction (XRD), X-ray fluorescence (XRF), inductivity-coupled plasma mass spectrometry (ICP-MS), and microscopy of coarse fraction as well as MSCL-logging and XRF-scanning.
- Reconstruction of surface-water sub-surface and deep-water characteristics: paleo-sea-ice distribution, surface-water productivity, sea-surface and deep-water temperature, deep-water ventilation, etc., using specific biomarkers (e.g., n-alkanes, sterols, alkenones; U^{k}_{37} Index, TEX_{86} Index, IP_{25} Index), micropaleontological proxies (dinoflagellates, foraminifers, ostracodes, etc.), and inorganic-geochemical proxies (stable isotopes, radiogenic isotopes, etc.). Analytical techniques to be used include LECO ($CaCO_3$, TOC, C/N), Rock-Eval pyrolysis, gas chromatography (GC), gas chromatography/ mass spectrometry (GC/MS), and high-performance liquid chromatography/mass spectrometry (HPLC/MS), XRF, ICP-MS, and microscopy as well as XRF scanning.
- Studies of sea ice and sea-ice sediments (biomarkers, mineralogy, geochemistry, biology, etc.).
- DNA approach for identifying (sea ice) algae in sea ice and sediment samples.

Data management

All data will be uploaded to the PANGAEA database. Unrestricted access to the data will be granted after about three years, pending analysis and publication.

References

Stein R (2017) From Greenhouse to Icehouse: The late Mesozoic-Cenozoic Arctic Ocean sea-ice and climate history. Polarforschung 87, 61-78.

Stein R, Jokat W, Niessen F and Weigelt E (2015) Exploring the long-term Cenozoic Arctic Ocean Climate History – A challenge within the International Ocean Discovery Program (IODP). Arktos 1, doi: 10.1007/ s41063-015-012-x

3. GEOPHYSICS: TECTONIC EVOLUTION OF THE ARCTIC OCEAN

3.1 Seismic reflection

E. Weigelt (AWI), K. Berglar (BGR), T. Ebert (BGR), T. Eggers (AWI), S. Freiman (MSU), C. Gaedicke (BGR), J. van der Krogt (AWI), N. Lensch (AWI), F. Niessen (AWI), A. Pfeiffer (AWI), A. Schmengler (AWI), J.R. Scholz (AWI), N. Wöhltjen (AWI), W. Jokat (AWI, not on board)

Objectives

The Lomonosov Ridge is one of the most prominent topographic features in the Arctic Ocean. It stretches from the northern Greenland Shelf to the Laptev Sea Shelf separating the Cenozoic Eurasia Basin from the Mesozoic Amerasia Basin. As a sliver of continental crust it rifted from the Siberian margin in early Paleocene at about 58 Ma (Chron 25) (e.g. Heezen and Ewing, 1961; Vogt et al., 1979; Kristoffersen, 1990) and subsided below sea level in the early Eocene (e.g. Jokat et al., 1995; Moran et al., 2006). Its tectonic evolution influenced ocean currents, which in turn influenced climate, sedimentation conditions, and even the setting of ecosystems in the adjacent Amundsen and Makarov basins (e.g. Jakobsson et al., 2007; Björk et al., 2018)). Most of these processes left an imprint on sedimentary layers and crust, which can be imaged with geophysical methods. The geophysical research topic aims to record a set of seismic reflection data, which will enhance insights into the tectonic evolution, sedimentation history, and paleoceanography of the Central Arctic Ocean. As well, these new data contribute to a better understanding of the link between tectonics and climate changes in the Arctic.

The first key activity of the geophysical work is to perform high resolution multichannel seismic reflection profiling across the central and the southern part of the Lomonosov Ridge for (a) imaging of sedimentary structures and crustal surface to reconstruct depositional systems and ocean circulations, and (b) supplementing the profiles obtained during *Polarstern* Expedition PS87 in 2014 in the surroundings of future IODP-drilling locations. To improve the pre-site survey, cross-lines to existing profiles shall enhance the imaging of sedimentary strata and the depth calculation of target reflectors (Fig. 4). The second key activity is to acquire a seismic line to connect with the seismic network at ACEX drilling location on the central Lomonosov Ridge and the seismic lines recorded on the south-eastern ridge for a spatial extrapolation of findings. All seismic investigations will be accomplished by continuous recording of gravity and magnetic data in international waters only to gain information on crustal structure and age.

Work at sea

Main work plan of the geophysics group comprises seismic profiling across the central and southern Lomonosov Ridge, supplementing the profiles obtained during *Polarstern* Expedition PS87 in 2014 (Fig. 4, Box 1). Additional seismic lines will be recorded on the southeastern Lomonosov Ridge. A further aim is to transfer the stratigraphic information the ACEX drilling location to the proposed new sites. (Fig. 4, Box 2). Gears to be used on-board within the geophysics programme are Airgun Frame (6 x 8 l volume), 600 m and 3,000 m Streamer. All seismic measurements will be accompanied by gravity and magnetic recording by an on-board KSS 31 Gravimeter and Fluxgate magnetometers, respectively.

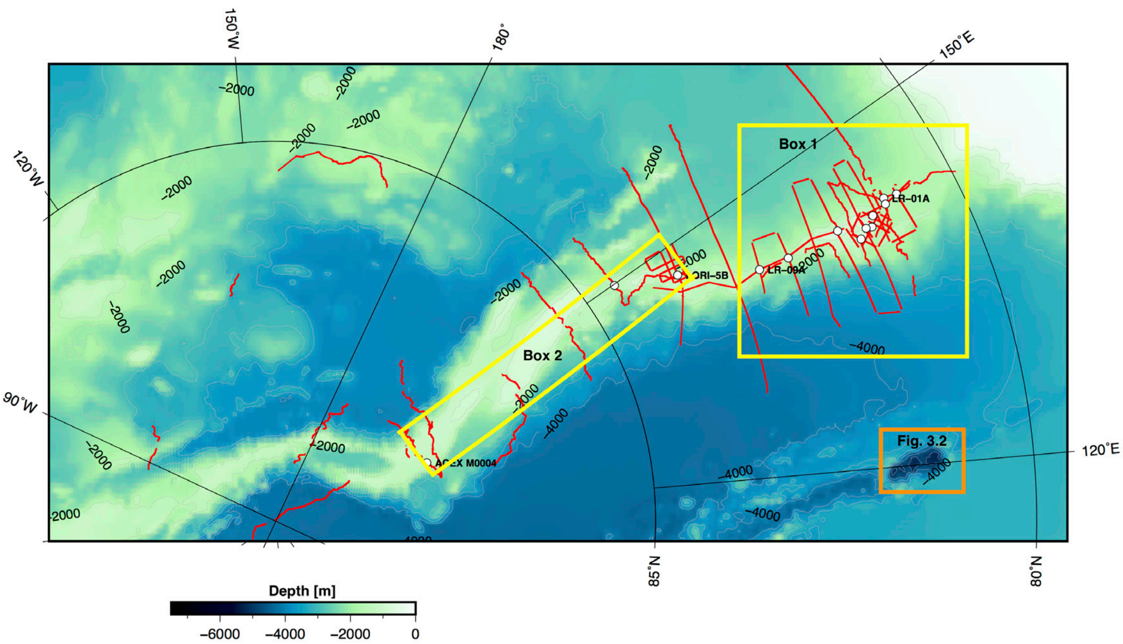

Fig. 4: Bathymetric map of the south-eastern Lomonosov Ridge. Boxes 1 and 2 show the location of the planned multichannel seismic reflection survey. Red lines mark the location of exiting seismic lines, white circles the location of projected drilling sites. The orange frame marks the possible OBS locations in the Gakkel Deep (see Fig. 5).

Expected results

Seismic lines gathered in 2008 and 2014 across and along the Lomonosov Ridge show a similar reflection characteristic for the upper seismic units indicating four major depositional stages in the southeastern Arctic Ocean (Weigelt et al., 2014). A prominent high-amplitude-reflector sequence (HARS) is the most striking feature in the Siberian part of the Arctic Ocean. It documents widespread changes in deposition conditions associated with the ongoing subsidence of the Lomonosov Ridge and gradual opening of the Fram Strait. The presence of the HARS is expected to be also visible on the new gathered seismic lines and will be taken as tie point for dating the strata above over a large region. Furthermore, we expect a similar reflection pattern of strata along the Lomonosov Ridge. A connection of seismic lines recorded on the south-eastern Lomonosov Ridge to lines around ACEX drilling location via the reflection characteristics will enable a spatial extrapolation of drilling results into a large area of the Arctic Ocean.

Data management

Seismic reflection data will be made available upon request after a phase of restricted access of 4 years after data acquisition.

References

Björk G, Jakobsson M, Assmann K, Andersson LG, Nilsson J, Stranne C, and Mayer L (2018) Bathymetry and oceanic flow structure at two deep passages crossing the Lomonosov Ridge. Ocean Sci., 14, 1–13, 2018, doi: 10.5194/os-14-1-2018.

Heezen B and Ewing M (1961) The mid-oceanic ridge and its extension through the arctic basin. In Raasch, G., editor, Geology of the Arctic, volume 1, pages 622-642. University of Toronto Press, Toronto.

Jakobsson M, Backman J, Rudels B, Nycander J, Mayer L, Sangiorgi F, Brinkhuis H, O'Regan M, Jokat W, Frank M, King J, Moran K (2007) The early Miocene onset of a ventilated circulation regime in the Arctic Ocean. Nature, 447, 987-990, doi:10.1038/ nature05924.

Jokat W, Weigelt E, Kristoffersen Y, Rasmussen T, Schöne T (1995) New insights into evolution of the Lomonosov Ridge and the Eurasian Basin. Geophys. J. Internat., 122, 378-392.

Jokat, W (2005) The sedimentary structure of the Lomonosov Ridge between 88°N and 80°N: Consequences for tectonic and glacial processes. Geophysical Journal International, 163, 698-726. doi:10.1111/j.1365-246X.2005.02786.x.

Kristoffersen Y (1990) Eurasian Basin, in: Grantz A, Johnson L, Sweeny JF (Eds.), The Arctic Ocean Region. Geology of North America Vol. L., Geol. Soc. Am., Boulder, Colorado, pp. 365-378.

Weigelt E, Franke D, Jokat W (2014) Seismostratigraphy of the Siberian Arctic Ocean and adjacent Laptev Sea Shelf. J. Geophys. Res. 119 (7), pp. 5275-5289.

3.2 Passive seismology

J. Scholz (AWI), not on board: V. Schlindwein, H. Kirk (AWI)

Objectives

Gakkel Ridge as one of the slowest spreading mid-ocean ridges on Earth is a key research target to better understand how new ocean lithosphere is being created with very little mantle melting. Despite the very low spreading rate at eastern Gakkel Ridge of less than 9 mm/y, a number of prominent volcanoes emerge from the sediment cover of the rift valley. There is an eye-catching depression in the rift valley floor at eastern Gakkel Ridge, called Gakkel Deep, that has recently caught scientific attention. It has been thought to result from a gigantic caldera collapse (Piskarev & Elkina, 2017), or been considered as mainly volcanic structure (Nikishin et al., 2017). We will investigate with our passive seismic experiment, whether Gakkel Deep is a volcanic structure or potentially its rims represent ejection material from a past eruption in which case we would not expect present day magmatic seismicity. In addition, this installation of a small-scale ocean bottom seismometer network on a presumably volcanic feature near the western termination of Gakkel Deep serves as a first test of our newly developed ocean bottom seismometers that can operate underneath dense sea ice. We further expect a valuable record of ocean noise during an entire year from an ice-marginal zone. We will record ocean micro-seismics and wave development in the increasingly open Arctic Ocean providing valuable information on the impact of wave action on sea ice.

Work at sea

For the passive seismology programme four sub-sea ice ocean bottom seismometers will be deployed near Gakkel Deep at distances of about 5-10 km (Fig. 5). The instruments are equipped with a Posidonia transponder and need to be tracked during their free fall to the seafloor. They will be recovered in 2019 after a recording period of about 12 months.

Expected results

OBS will only be recovered after a recording period of one year, such that no results can be expected from this cruise.

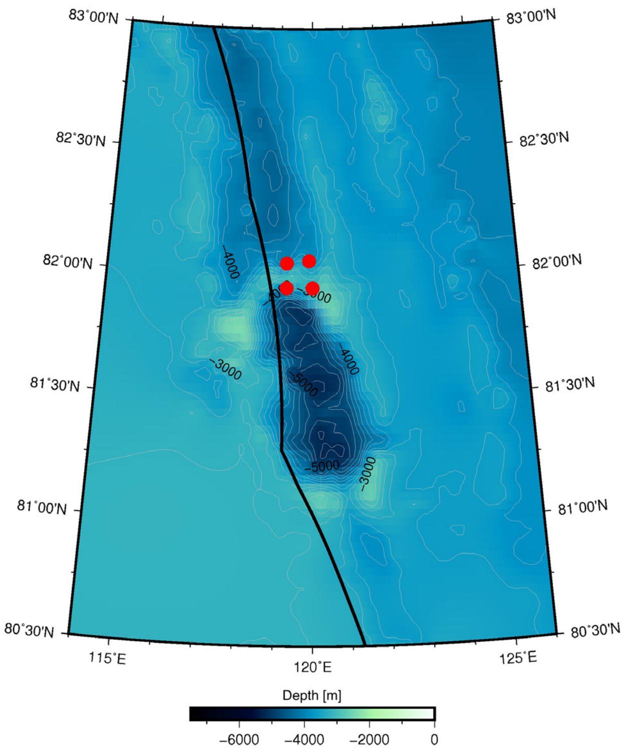

Fig. 5: Bathymetric map of the Gakkel Deep with the potential OBS locations (red dots). The black lines mark the border of the Exclusive Economic Zone versus Russia.

Data management

Passive seismic data will be made available through GEOFON after a phase of restricted access of four years after instrument recovery in 2019.

References

Nikishin AM, Gaina C, Petrov EI, Malyshev NA, Freiman SI (2017) Eurasia Basin and Gakkel Ridge, Arctic Ocean: Crustal asymmetry, ultraslow spreading and continental rifting revealed by new seismic data, Tectonophysics, in press.

Piskarev A, Elkina D (2017) Giant caldera in the Arctic Ocean: Evidence of the catastrophic eruptive event. Scientific Reports, 7, 46248, doi: 10.1038/srep46248.

Vogt PR, Taylor PT, Kovacs LC, Johnson GL (1979) Detailed aeromagnetic investigations of the Arctic Basin, Jour. Geophys. Res. 84: 1071-1089.

4. BATHYMETRY

S. Andree, L. Oberwinster, M. Steffen (AWI)
not on board: Boris Dorschel, Simon Dreutter (AWI)

Objectives

Accurate knowledge of the seafloor topography, hence high resolution multibeam swath bathymetry data, is key information necessary to understand marine processes and the glacial history of polar continental margins. It is of particular importance for the interpretation of oceanographic, geological and biological data in a spatial context. For geological studies, bathymetry data can moreover provide valuable information on the glacial history of an area by revealing the geomorphology of the seafloor, i.e. sub- and proglacial bedforms. Potential sediment depo-centres and areas of erosion can be identified by combining data on seafloor topography collected with swath bathymetry systems with information about sub-seafloor composition and stratigraphy derived from acoustic sub-bottom profiling. Seafloor depressions, for example, may act as sediment traps, whereas steep slopes and escarpments are often affected by erosion, thereby exposing old, hard and laterally variable substrate. Furthermore, seabed topography and seafloor substrate are key environmental parameters for benthic ecosystems, and consequently their characterization will allow for habitat classifications. Hydroacoustic data furthermore provide valuable information for site selection for the other scientific working groups on board.

Work at sea

The main task of the bathymetry group is to plan and run surveys using the Atlas Hydrosweep DS3 systems in the study area and during transit, to provide information for station planning and sediment sampling. The raw bathymetric data will be corrected for sound velocity changes in the water column and further processed and cleaned for erroneous soundings and artefacts on board. Detailed seabed maps derived from the bathymetric data will provide information on the general and local topographic setting of the survey area and on the distribution of glacial-geomorphological features and erosional structures (channels, gullies) and depositional features (slumps, slides, fans). High resolution seabed data recorded during the surveys will promptly be made available for site selection and cruise planning. The acoustic surveys will be carried out by three operators in a 24/7 shift mode.

Expected results

Expected results will consist of high-resolution seabed maps along the cruise track and from the target research sites. The bathymetric data will be analyzed to provide geomorphological information of the research area. Expected outcomes aim towards a better understanding of the geological and, particularly, the sedimentary processes in the research area.

Data management

Bathymetric data collected during the expedition will be stored in the PANGAEA data repository at the AWI. Furthermore, the data will be provided to mapping projects and included in regional data compilations such as IBCAO (International Bathymetric Chart of the Arctic Ocean) and GEBCO (General Bathymetric Chart of the Ocean). Bathymetric data will also be provided to the Nippon Foundation – GEBCO Seabed 2030 Project.

5. MELT WATER CHARACTERISTICS DURING REFREEZING

G. Birnbaum (AWI), M. König (CAU), N. Fuchs (AWI), N. Oppelt (AWI, not on board)

Objectives

Improving the predictive capabilities for the development of Arctic sea ice cover strongly depends on a better understanding of the ice-albedo feedback mechanism. There is still a lack of knowledge about the temporal and spatial dynamics of melt ponds and their role in the Arctic climate and ecosystem. The investigation of melt pond characteristics during refreezing complements earlier measurements during PS106, when melt ponds formed and evolved. Using a combination of multi- and hyperspectral airborne imagery, field spectroscopy and bio-optical modelling we aim to quantify melt pond fraction, pond size distribution and surface albedo in different ice regimes, and additionally, if ponds are still open, melt pond depth, thickness of underlying ice and pond water constituents (chlorophyll, total suspended matter and coloured dissolved organic matter). The main goal is to develop a semi-automated application for melt pond analysis for airborne hyperspectral instruments. A further goal is to employ the collected data to validate and improve parameterizations of melt pond properties used in regional and global climate models. Ground-based measurements of sea ice and pond characteristics accompany airborne data acquisition. The ground-based measurements are essential for the parameterization of bio-optical models as well as for the validation of the results, which is crucial for accuracy assessment. As long as we operate in open water, we acquire ocean colour ground-truth data for satellite missions.

Work at sea

a) Airborne acquisition of sea ice and melt pond characteristics

Airborne measurements will be carried out by use of a helicopter. Two instruments will be mounted at the helicopter, a Canon DSLR camera and an AISAeagle hyperspectral camera. To couple ground based and airborne measurements, the flight pattern will include several overflights of sampling areas on selected ice floes. The majority of helicopter flights will be focused, however, on spatial variability of pond characteristics, hence, they will not include overflights of sampled ice floes.

b) Measurements of melt pond characteristics

Optical properties of open ponds will be determined using measurements of absorption from water samples (PSICAM, LWCC). For shallow and frozen ponds surface reflectance will be determined using field spectrometers (ASD, OceanOptics). Pond depth will be measured along transects using rulers. Measurement positions will be determined using laser distance meters.

c) Measurements of open water optical properties

As long as we operate in open water, inherent optical properties of the water will be determined from a Zodiac using submersible radiometers (TRIOS RAMSES). Additionally, surface water samples will be collected and analysed as described in the following. The data is supposed to be used as ground-truth for ocean colour satellite missions.

d) Determination of optically-active water constituents

Optically active water constituents are determined in the lab by means of absorption spectroscopy using water samples taken during ice station. The aim is to determine the main optical properties of melt ponds/open water: inherent optical properties of the water samples as well as concentrations of chlorophyll (biomass), total suspended matter (TSM), and coloured dissolved organic matter (CDOM). Chlorophyll concentrations will additionally be deduced via fluorescence measurements using an AlgaeTorch.

Water samples will be collected at different melt ponds and open water and analysed in the wet-laboratory on board. Laboratory work includes:

- Measurements of the TSM absorption using a PSICAM,
- Filtration of water samples (filters will be deep frozen and stored for later analysis), and
- Measurements of CDOM absorption using PSICAM and LWCC.

Snow and ice sampling will be performed in collaboration with Dr. Heike Zimmermann (AWI-P) and the ArcTrain group.

Expected results

The measurements are expected to provide:

1. For ponds, linear profiles of pond depth and size;
2. Hyperspectral irradiance reflectance above-water and remote sensing; reflectance in-water to characterize the optical properties of melt ponds;
3. Hyperspectral irradiance reflectance reference measurements of snow and ice;
4. Inherent optical water properties of water samples as well as concentrations of chlorophyll, organic and inorganic matter;
5. Spectral characterization of ponded sea ice surface for atmospheric correction of airborne data;
6. Maps of pond fraction, pond depth, thickness of underlying ice as well as sea ice and pond albedo from airborne data;
7. Measurements will be used to develop remote sensing algorithms for long-term monitoring of melt pond depth, thickness of underlying ice and content of organic and inorganic substances;
8. Measurements will be further used to validate and improve parameterizations of melt pond properties used in regional and global climate models.

Data management

All sea ice data collected during PS 115.2 will be delivered to the PANGAEA database and to the appropriate national data centres after post-cruise calibration and processing.

6. DEPLOYMENT OF DRIFTING BUOYS

6.1 Deployment of drifting buoys: A contribution to the "Year of Polar Prediction" (YOPP)

G. Spreen (UoB-IEP), not on board: M. Hoppmann (AWI), S. Dolk (NOAA),
I. Rigor, H. Goessling (AWI)

Objectives

The mission of the Year Of Polar Prediction (YOPP) is to enable breakthroughs in environmental prediction capabilities for the Polar Regions and beyond. The core period of YOPP, which takes place between mid-2017 to mid-2019, will entail periods of enhanced observational and modelling campaigns in both the Arctic and the Antarctic. This will allow carrying out subsequent forecasting system experiments aimed at optimizing observing systems in the polar regions and providing insight into the impact of better polar observations on forecast skills in lower latitudes.

One particular component that needs to be better predicted, and hence analyzed, is the general atmospheric circulation in the Polar Regions. A lot of activities like satellite remote sensing, core modelling & prediction, field campaigns, and Special Observing Periods (SOPs) are being conducted during the YOPP core phase to fill this gap.

One of the biggest challenges for weather forecasts and numerical weather simulations is the scarcity of *in-situ* observations of two of the most critical parameters, surface pressure and air temperature, in remote areas and especially in winter months. Indeed, in spite of many satellite systems, measuring surface parameters remains a challenging task in the polar regions, as cloud cover and the background sea ice pose specific issues to most satellite instruments (infra-red or microwave-based), as compared to other regions of the globe. One important aim of YOPP is to enhance the routine *in-situ* observations in an attempt to demonstrate that closing the data gaps in the conventional Arctic and Antarctic observing systems may bring significant value for global applications.

In the framework of the International Arctic Buoy Programme (IABP) and its numerous collaborators, a network of ice-tethered buoys is maintained in the Arctic Ocean since several decades. Depending on the availability of funding and, more importantly, the logistical challenges, the coverage of this network varies a lot between the years. Motivated by the Arctic SOPs in Jul/Aug/Sep 2018 and Feb/Mar 2020, we plan to support the efforts of YOPP by deploying a number of buoys during *Polarstern* Cruise PS115/2 in September/October 2018. These deployments will be made in the Nansen Basin, where currently no single observation is being made, complementing deployments from many other vessels in other regions of the Arctic Ocean in 2018.

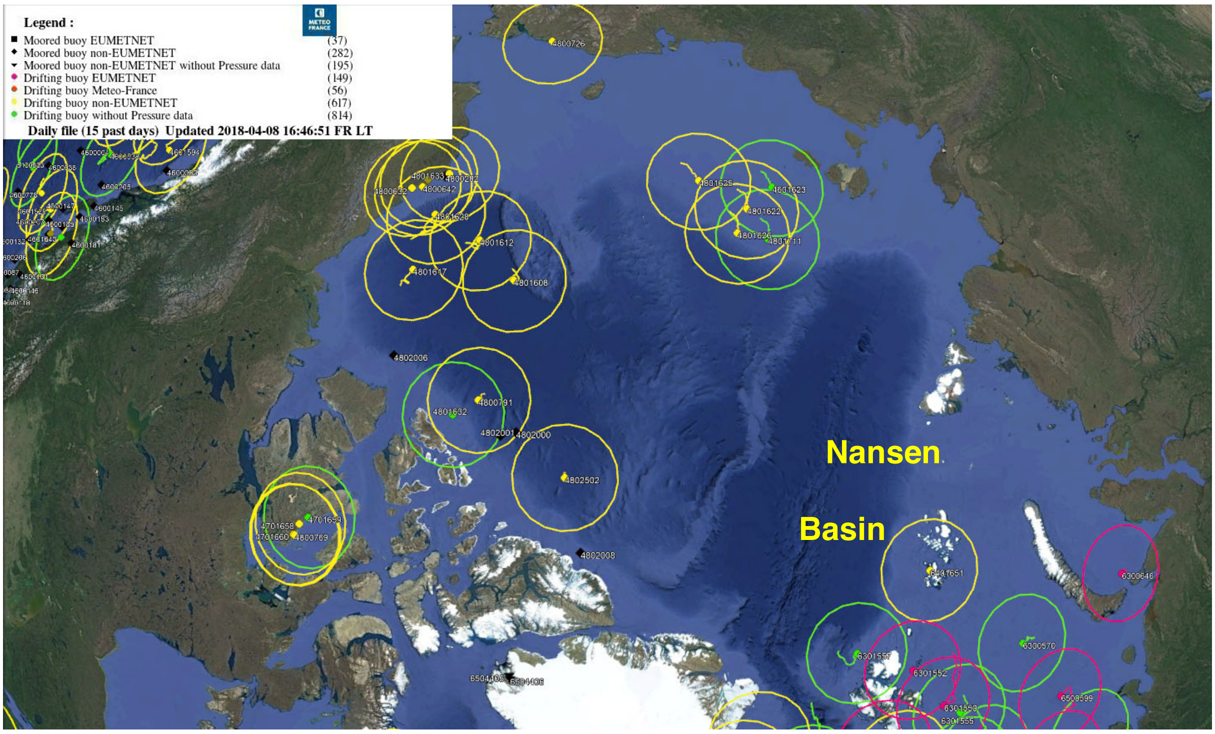

Fig. 6: The (sparse) March 2018 network of drifting buoys in the Arctic that report meteorological data into the Global Telecommunications System (GTS). The circles indicate a radius of 250 km around a buoy. Figure created using Google Earth with help from Paul Poli and data from ESurfmar/EUMETNET.

Work at sea

During the transit to the main work area over the southern Lomonosov Ridge, a total of 9 Surface Velocity Profilers with surface temperature and barometric pressure sensors (SVP-Bs) will be deployed from *Polarstern* either in open water (dropped from the working deck into the sea) or on sea ice (during helicopter stations). The target area of deployment is the Nansen Basin indicated on the map in Fig. 6.

Expected results

The buoys are expected to fill a critical observational gap of temperature and barometric pressure data in the central Arctic Ocean buoy network, which is particularly pronounced in the under-observed Eurasian Basin (see Fig. 6). The data will contribute to an improvement of weather forecasts even down to mid-latitudes, and serve as validation for numerical simulations of the atmosphere, ice and ocean, as well as for remote sensing products. These aspects are of particular importance for the efforts currently undertaken within the framework of the Year of Polar Prediction and its Special Observing Periods in Jul/Aug/Sep 2018 and Feb/Mar 2020.

In addition to operational forecasting centers, academic university and government researchers will potentially use the observations, not only to assess forecast impacts to guide the future polar observing system, but also to better understand the polar weather and climate system with its unique physical environment, *e.g.,* to improve polar model parameterizations (Jung et al., 2016).

Data management

Immediately upon measurement, the buoy data is transmitted to the buoy programme manager via the iridium satellite network. The data is then delivered into the Global Telecommunications System (GTS) in near-real time, and is freely available in the public GTS database approximately 10 minutes after the measurement time. The buoys also contribute to the public database hosted by the International Arctic Buoy Programme (IABP). Note that all buoy data are publicly available: WMO (1995) Resolution 40 Annex I considers such data among those "to be exchanged without charge and with no conditions on use".

References

Jung T, Gordon ND, Bauer P, Bromwich DH, Chevallier M, Day JJ, Dawson J, Doblas-Reyes F, Fairall C, Goessling HF, Holland M, Inoue J, Iversen T, Klebe S, Lemke P, Losch M, Makshtas A, Mills B, Nurmi P, Perovich D, Reid P, Renfrew IA, Smith G, Svensson G, Tolstykh M, and Yang Q (2016) Advancing Polar Prediction Capabilities on Daily to Seasonal Time Scales. Bull. Amer. Meteor. Soc., 97, 1631–1647, https://doi.org/10.1175/BAMS-D-14-00246.1A.1.

WMO (1995) Cg-XII Resolution 40. Available on-line http://www.wmo.int/pages/prog/hwrp/documents/wmo_827_enCG-XII-Res40.pdf (last accessed 9 April 2018).

6.2 Deployment of drifting buoys: A pre-study for the multidisciplinary drifting observatory for the study of Arctic climate (MOSAiC) in 2019/20

G. Spreen (UoB-IEP), not on board: M. Hoppmann, T. Krumpen, M. Janout, M. Nicolaus, B. Rabe, Helge Goessling (AWI)

Objectives

The upcoming *Multidisciplinary drifting Observatory for the Study of Arctic Climate* (MOSAiC) is a major, year-round expedition into the central Arctic Ocean. The MOSAiC Observatory will be deployed in the Arctic sea-ice pack in fall 2019, and drift with it for a full annual cycle. The deployment location north of the Laptev Sea is critical to ensure that the vessel follows the Transpolar Drift towards the North Pole, and then drifts further to the Fram Strait, where it will finally leave the Arctic Ocean.

In order to better understand the sea-ice drift patterns in, or adjacent to, the potential MOSAiC deployment region, several GPS drifters will be deployed on sea ice during PS115/2's stay in the main work area along the southern Lomonosov Ridge.

Work at sea

A total of 10 Iridium GPS drifters will be deployed on sea ice within the main working area. The deployments will be performed opportunistically by helicopter, ideally in connection with other ice work. The aim is to establish a regular buoy grid within an area of a few 100 km^2, which will however mostly depend on the actual cruise track, helicopter availability and flight weather.

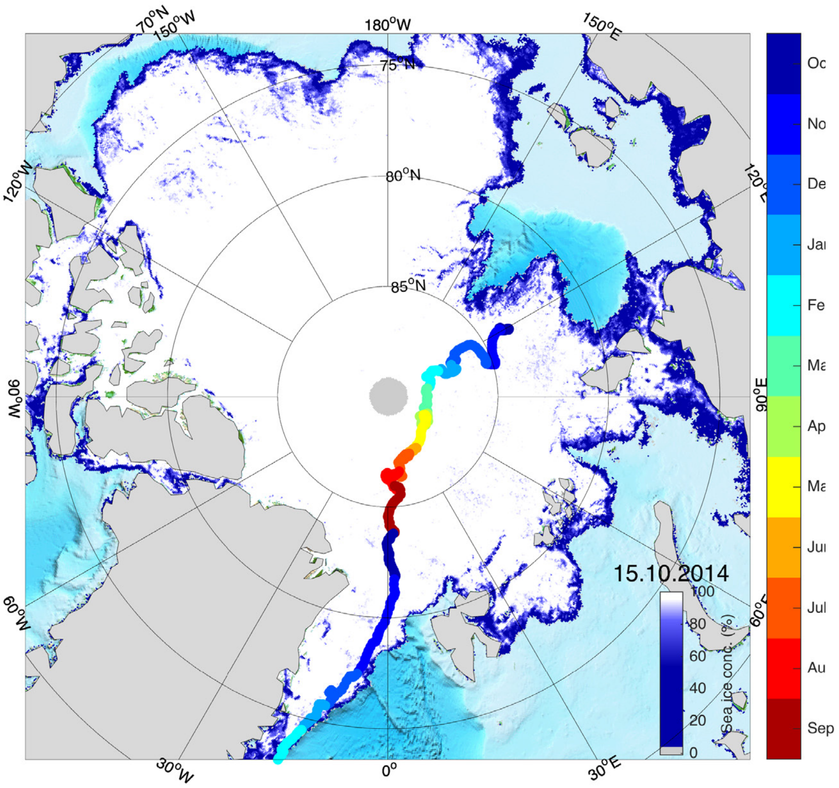

Fig. 7: Potential drift trajectory of the Polarstern for the selected starting position at 120° E and 84° N. Colors represent the month of the drift starting in October 2019 and ending in October 2020. The small color bar illustrates the sea ice concentration on October 15th 2014 (taken from MOSAiC website on 13 April 2018).

Expected results

The PS115/2 main working area is close to the expected starting position of MOSAiC at 120-130°E (Fig. 7). The grid of GPS drifters will allow to analyse a potential drift trajectory of the MOSAiC distributed network and how the network will deform during the one-year long drift. The MOSAiC trajectory and behaviour of the distributed network (e.g., divergence and shear of the grid) can later be compared to the buoy grid deployed during PS115/2 to evaluate inter-annual differences.

Data management

Immediately upon measurement, the buoy data is transmitted to the buoy programme manager via the iridium satellite network. The data is then delivered into the Global Telecommunications System (GTS) in near-real time, and is freely available in the public GTS database approximately 10 minutes after the measurement time. The buoys also contribute to the public database hosted by the International Arctic Buoy Programme (IABP). Note that all buoy data are publicly available: WMO (1995) Resolution 40 Annex I considers such data among those “to be exchanged without charge and with no conditions on use”.

References

WMO (1995) Cg-XII Resolution 40. Available on-line http://www.wmo.int/pages/prog/hwrp/documents/wmo_827_enCG-XII-Res40.pdf (last accessed 9 April 2018)

7. THE "YEAR OF POLAR PREDICTION" (YOPP): ADDITIONAL RADIOSOUNDINGS DURING THE SPECIAL OBSERVING PERIOD

H. Schmithüsen (AWI, not on board), D. Olonschek (MPI)

Objectives

The „Year of Polar Prediction" (YOPP) is one of the key elements of the Polar Prediction Project (PPP, www.polarprediction.net). Its mission is:

Enable a significant improvement in environmental prediction capabilities for the polar regions and beyond, by coordinating a period of intensive observing, modelling, verification, user-engagement and education activities.

To contribute to the special observing efforts of YOPP the radiosounding activity on board *Polarstern* is increased to 4 soundings per day. This follows the internationally compiled science plan of PPP[1] and the recommendations in the implementation plan[2] of the project.

Work at sea

Whenever *Polarstern* is north of 60°N, the routinely launched daily radiosounding is extended by another 3 soundings per day. Together, the soundings cover all synoptic main hours, namely 00, 06, 12 and 18 UTC.

Data management

Data management is identical to the routinely performed radiosoundings. Data on board will be made available through the DWD staff to any interested scientist. Data will be published on Pangaea after the cruise. Any scientific publication shall use the data from PANGAEA.

References

World Weather Research Programme (2013) WWRP Polar Prediction Project Science Plan. WWRP/PPP No. 1. World Meteorological Organization, Geneva. http://www.polarprediction.net/fileadmin/user_upload/www.polarprediction.net/Home/Documents/Final_WWRP_PPP_Science_Plan.pdf.

World Weather Research Programme (2016) WWRP Polar Prediction Project Implementation Plan for the Year of Polar Prediction (YOPP), Version 2.0. WWRP/PPP No. 4. World Meteorological Organization, Geneva. http://www.polarprediction.net/fileadmin/user_upload/www.polarprediction.net/Home/YOPP/YOPP_Documents/FINAL_WWRP_PPP_YOPP_Plan_28_July_2016_web-1.pdf.

8. THE „ARCTRAIN“ FLOATING UNIVERSITY

R. Stein (AWI), G. Spreen (UoB-IEP), M. Kucera (UoB-MARUM, not on board), A. de Vernal (UQAM, not on board) and the PS115/2 ArcTrain PhD and Master students

Background and objectives

Due to a complex set of feedback processes collectively known as “polar amplification”, the Arctic realm is expected to experience a greater-than-average response to global climate forcing. The cascades of feedback processes that connect the Arctic cryosphere, ocean and atmosphere remain incompletely constrained by observations and theory and are difficult to simulate in climate models. Our capacity to predict the future of the region and assess the impacts of Arctic change processes on global and regional environments hinges on the availability of interdisciplinary experts with strong international experience and understanding of the science/society interface. This is the basis of the International Research Training Group “Processes and impacts of climate change in the North Atlantic Ocean and the Canadian Arctic - ArcTrain“, which was initiated in 2013 and will be funded until 2022. ArcTrain aims to educate PhD students in an interdisciplinary environment that combines paleoclimatology, physical oceanography, remote sensing and glaciology with comprehensive Earth system modelling, including sea-ice and ice-sheet components. The qualification programme for the PhD students includes joint supervision, mandatory research residences at partner institutions, field courses on land and on sea (Floating University), annual meetings and training workshops and a challenging structured training in expert skills and transferrable skills. Its aim is to enhance the career prospects and employability of the graduates in a challenging international job market across academic and applied sectors.

ArcTrain is a collaborative project at the University of Bremen and the Alfred Wegener Institute for Polar and Marine Research in Bremerhaven. The German part of the project is designed to continue for nine years and educate three cohorts of twelve PhD students each. The Canadian partners comprise a consortium of eight universities led by the GEOTOP cluster at the Université du Québec à Montréal and including Dalhousie University, McGill University, Memorial University of Newfoundland, University of Alberta, University of British Columbia, University of Calgary and Université du Québec à Rimouski.

Further details about ArcTrain are available at: https://www.marum.de/ArcTrain.html

Work at sea

As part of the ArcTrain qualification programme, a “floating University” will be held onboard *Polarstern* during the PS115/2 Expedition. About 16 Canadian and German PhD students with very different scientific backgrounds (i.e., oceanography, geosciences and modelling) will be introduced into the different technical aspects of field work in marine sciences. The students will assist the different working in all kind of activities on the aft deck and in the laboratories, and they will be involved in the evaluation and interpretation of the shipboard scientific data. Besides the practical work, seminars will be carried out with presentations by the ArcTrain PhD students as well as the senior scientists involved in the PS115/2 scientific programme. Finally, reports about the shipboard activities should be written by the ArcTrain students.

9. BETEILIGTE INSTITUTE / PARTICIPATING INSTITUTES

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BGR	Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) Department B1.4 Stilleweg 2 30644 Hannover Germany
CAU	Institute for Geography Christian-Albrechts-Universität zu Kiel Ludewig-Meyn-Str. 14 24118 Kiel Germany
DWD	Deutscher Wetterdienst Geschäftsbereich Wettervorhersage Seeschifffahrtsberatung Bernhard-Nocht-Str. 76 20359 Hamburg Germany
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McGill	Department of Atmospheric and Oceanic Sciences McGill University 805 Sherbrooke Street West Montreal Quebec, H3A 0B9 Canada
MPI	Max Planck Institute for Meteorology Bundesstr. 53 20146 Hamburg Germany
MSU	Geology Department Moscow State University Leninskie Gory 1 119234 Moscow Russian Federation
MUoN	Department of Physics and Physical Oceanography Memorial University of Newfoundland 283 Prince Philip Drive A1B 3X7 St. John’s Canada
NOAA	National Oceanic & Atmospheric Administration 4301 Rickenbacker Cswy Miami, Florida 33149 USA
UoAE	Department of Earth & Atmospheric Sciences 1-26 Earth Sciences Building University of Alberta Edmonton Edmonton, Alberta, T6G 2E3 Canada
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UoC	Department of Geography University of Calgary 2500 University Dr NW, AB T2N 1N4 Calgary Canada
UoM	Institute for Geology and Paleontology University of Münster Corrensstr. 24 48149 Münster Germany
UoStP	University of St. Petersburg Universitetskaya 7-9 199034 St. Petersburg Russian Federation
UoT	Department of Geosciences The Arctic University of Norway Dramsveien 201 9037 Tromsø Norway
UoW	Applied Physics Laboratory University of Washington (APL-UW) 1013 NE 40th St, Seattle, WA 98105 USA
UQAM	GEOTOP & Département des Sciences de la Terre Université du Québec à Montreal CP 8888 Montréal Québec, H3C 3P8 Canada
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	Name	First name	Institute	Profession
1	Andree	Sophie	AWI	Bathymetry
2	Benson	Ovie Miracle	AWI	Geology
3	Berglar	Kai	BGR	Geophysics
4	Birnbaum	Gerit	AWI	Remote sensing/sea ice
5	Bourgault	Pascal	McGill	PhD student ArcTrain
6	Brice	Camille	UQAM	PhD student ArcTrain
7	Brunette	Charles	McGill	PhD student ArcTrain
8	Caron	Myriam	UQAR	PhD student ArcTrain
9	de Jager	Harold	HeliService	HeliService
10	Desmarais	Amelie	McGill	PhD student ArcTrain
11	Dröllner	Maximilian	UoM	Geology
12	Ebert	Timo	BGR	Geophysics
13	Eggers	Thorsten	AWI	Geophysics
14	Freiman	Sergei	MSU	Geophysics
15	Fuchs	Niels	AWI	Remote sensing/sea ice
16	Gaedicke	Christoph	BGR	Geophysics
17	Heim	Thomas	HeliService	HeliService
18	Ienny	Rémi	UoB-MARUM	PhD student ArcTrain
19	Kazlova	Aliaksandra	UoB-IEP	PhD student ArcTrain
20	König	Marcel	CAU	Remote sensing/sea ice
21	Lemmel	Frithjof	Geomar	Geology
22	Lensch	Norbert	AWI	Geology & Geophysics
23	Love	Ryan	MUoN	PhD student ArcTrain
24	Ludwig	Valentin	UoB-IEP	PhD student ArcTrain
25	Miller	Max	DWD	DWD
26	Murashkin	Dimitrii	UoB-IEP	PhD student ArcTrain
27	Niessen	Frank	AWI	Geophysics
28	Oberwinster	Lamis	AWI	Bathymetry
29	Olonscheck	Dirk	MPI	Meteorology
30	Pfeiffer	Adalbert	AWI	Geology & Geophysics
31	Piotrowski	Lukas	HeliService	HeliService
32	Popova	Elena	UoStP	Geology (POMOR student)
33	Ridenour	Natasha	UoAE	PhD student ArcTrain
34	Ringeisen	Damien	AWI	PhD student ArcTrain
35	Rohleder	Christian	DWD	DWD
36	Samimi	Samira	UoC	PhD student ArcTrain
37	Santos	Victor	HeliService	HeliService
38	Sassenroth	Cynthia	UoStP	Geology (POMOR student)

	Name	First name	Institute	Profession
39	Schmengler	Almut	AWI	Geophysics
40	Scholz	John-Robert	AWI	Geophysics
41	Schreck	Michael	UoT	Geology
42	Spreen	Gunnar	UoB-IEP	PI ArcTrain (Remote sensing)
43	Steffen	Melanie	AWI	Bathymetry
44	Stein	Ruediger	AWI	Chief scientist/Geology
45	van der Krogt	Jolien	AWI	Geophysics
46	Vlug	Anouk	UoB-MARUM	PhD student ArcTrain
47	Weigelt	Estella	AWI	Geophysics
48	Wöhltjen	Nikolai	AWI	Geology & Geophysics
49	Wu	Junjie	AWI	Geology
50	Zimmermann	Heike	AWI-P	Geology & sea ice

11. SCHIFFSBESATZUNG /SHIP'S CREW

No.	Name	Rank
01.	Wunderlich Thomas	Master
02.	Grundmann Uwe	1.Offc.
03.	Westphal Henning	Ch.Eng.
04.	Fischer Tibor	2.Offc.Lad.
05.	Hering Igor	2.Offc.
06.	Peine Lutz	2.Offc.
07.	Jaeger Norbert	Doctor
08.	Dr.Hofmann Jörg	Comm.Offc.
09.	Schnürch Helmut	2.Eng.
10.	Brose. Thomas	2.Eng.
11.	Rusch Torben	2.Eng.
12	Brehme Andreas	Elec.Tech.
13.	Frank Gerhard	Electron.
14.	Markert Winfried	Electron.
15.	Winter Andreas	Electron.
16.	Feiertag Thomas	Electron.
17.	Sedlak Andreas	Boatsw.
18.	Neisner Winfried	Carpenter
19.	Clasen Nils	A.B.
20.	Schröder Norbert	A.B.
21.	Burzan Gerd-Ekkehard	A.B.
22	Hartwig-Labahn Andreas	A.B.
23.	Fölster Michael	A.B.
24.	Müller Steffen	A.B.
25.	Brickmann Peter	A.B.
26.	Schröder Horst	A.B.
27.	Beth Detlef	Storekeep.
28.	Neumann Niels	Mot-man
29.	Waterstradt Felix	Mot-man
30.	Krösche Eckard	Mot-man
31.	Dinse Horst	Mot-man
32.	Watzel Bernhard	Mot-man
33.	Meißner Jörg	Cook
34.	TupyMario	Cooksmate
35.	Martens Michael	Cooksmate
36.	Wartenberg Irina	1.Stwdess

No.	Name	Rank
37.	Tscheuschner Andre	Stwd/KS
38.	Hischke Peggy	2.Stwdess
39.	Mack Ulrich	2.Stwdess
40.	Krause Tomasz	2.Steward
41.	Hu Guo yong	2.Steward
42.	Chen Quan Lun	2.Steward
43.	Ruan Hui Guang	Laundrym.